

University of Cape Town



Strategies to overcome challenges when implementing an Enterprise Engineering Innovation Life-cycle

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University of Cape Town**

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by

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Abbreviations and Acronyms

BRR	Business Requirements Review
CDR	Critical Design Review
DEMO	Design and Engineering methodology for Organizations
DCP	Decision Check Points
DoDAF	Department of Defence Architecture Framework
EA	Enterprise architecture
EE	Enterprise Engineering
EEILC	Enterprise Engineering Innovation Life Cycle
FinTech	Financial Services Technology
GERAM	Generic Enterprise Reference Architecture for Enterprise Integration
IEEE	Institute for Electrical and Electronics Engineers
INOSE	International Council on Systems Engineering
ISO	International Standards Organization
IT	Information Technology
PDR	Preliminary Design Review
PRR	Production Readiness Review
PSS	Product Services System
PWC	Price Waterhouse Cooper
SME	Subject matter expertise
TRR	Test Readiness Review

ABSTRACT

The delivery of innovative IT solutions that support business strategy is an increasing, growing competitive aspect of organisations in the financial sector. Previous research has shown the need to follow an innovative or a more agile and flexible methodology when delivering IT solutions to save cost and enable the solutions to reach the consumer market as soon as possible. To apply agile/innovative methodologies across large organisations requires more alternative approaches than to implement them in small enterprises.

The organisation used in the case study, implemented an enterprise engineering innovative life-cycle (EEILC). Limited research has been done concerning the challenges and strategies during implementation of an enterprise engineering innovative life-cycle (EEILC). The purpose of this study was to investigate the strategies to overcome the challenges when implementing an enterprise engineering innovative life-cycle (EEILC). The research was inductive qualitative following an in-depth case study approach. The researcher conducted a case study using documentation analysis, informal interviews, in-depth interviews and observations with multiple stakeholders who are experts in their fields of software design and development. An inductive grounded theory approach was followed using a case study within an organisation in the financial sector in South Africa.

Results show there are seven core category challenges when implementing an innovation life cycle. Each of these core challenges has a core enterprise strategy to address the challenges occurring in the applicable domain. The core challenges are: (1) innovation process challenges (addressed by an agile product delivery innovation strategy) (2) invention challenges (addressed by an idea management strategy) (3) business model challenges (addressed by a client's value proposition strategy), (4) commercialization challenges, which include implementation and operations challenges, (addressed by a product portfolio management strategy), (5) culture challenges (addressed by an innovation culture strategy) and (6) knowledge management challenges and strategy, and (7) innovation management related challenges and strategy. An innovation management strategy will manage all these challenges.

Most prominent is the innovation management strategy which has links to all other categories in other domains. The relationship between enterprise client value proposition strategy show that enterprise client value proposition serves as a coherent link between how the innovation life cycle is adopted or changed to address the enterprise client value chain. This is driven by demand management to align between business and IT regarding the business model and application portfolio alignment. Thereafter, the alignment between the demand for enterprise application capabilities and the business service portfolio is shown. This is supported by service-oriented architecture (SOA) services. The resource management must make sure the right resources, competencies and skills are available to deliver the product portfolio. During innovation and life-cycle's execution, there is a lot of interaction between individuals and teams. Therefore, communication and culture play a vital role to create synergies by collaboration of work practice and living the values of the organization.

Through grounded theory analysis, a practical theory was developed, to show how challenges that occur during implementation of an innovation life-cycle, based upon enterprise engineering principles, can be addressed by best by putting the right strategies in place. This theory contributes to the body of knowledge by providing data and analysis from practical insight into how an innovation life cycle can be implemented. The challenges thereof and the mitigating strategies make it work. This study also suggested the key re best practices for enterprise architecture driving such an implementation. The research is an area of interest for development or customizing an Innovation Life-cycle using an Enterprise Engineering Framework.

Keywords: Enterprise Engineering, Innovation Life-Cycle, Innovation Life-Cycle Strategy, Governance, Innovation Life Cycle Challenges

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A note regarding prior publication

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This thesis is considered the source of the research study, the publication is cited in the thesis but no duplication of work occurs.



1

Introduction

This chapter is the introductory chapter of this thesis. It comprehends the background of the purpose of the study; the research objectives explaining overall goal and intention; the research context concisely introduce the context of the research problem; the research methodology overview to explain the research approach; the preliminary literature review purpose and the research outcome. The section is the document layout which concludes with the applied rationale of the document flow to the thesis.



1.1 Background

Most organisations implement and use some type of innovation life cycle, allowing technology to enable the business to achieve its business strategic goals (Werker, 2003). IT departments in large organisations need to deliver solutions to support business, remain at the forefront as well as offer value for money as quickly as possible to customers. The approach to adopt an innovation life cycle will affect the competitive advantage it delivers (Aleixo, & Tenera, 2009). The strategies employed to improve IT project performance while using an enterprise engineering innovation life-cycle is thus crucial for success (Kautz, & Nielsen, 2004).

Gong (2012) also reasons that IT organisations need a sound reference architecture to design dynamic business processes to enable organisations to achieve higher levels of flexibility, agility and innovation. It is in this area of research that the dissertation will be focusing, i.e. the application of an enterprise engineering framework to implement an innovation life cycle delivering business solutions end to end. In another study (Molnar, & Proper, 2013) applied enterprise engineering principles suggested various practices, including the characteristic readiness of an organisation to embark on application of enterprise engineering principles in its organisation.

The research field of enterprise engineering has vast potential and there are areas that can still expand considerably. A study about what research has been done in the enterprise engineering field by Molnar and Korhonen (2014) has shown that the enterprise engineering field is focused on using DEMO methodology and ontology approaches whereas, there is a need for alternative research paradigms. The limitations of only focusing on one functional paradigm, like DEMO, become obvious. There are other, more generic approaches e.g. Generic Enterprise Reference Architecture for Enterprise Integration by Bernus, Noran & Molina (2015) and Department of Défense Architecture Framework by Chaharsooghi & Achachlouei, (2011) instead of using the DEMO methodology which is currently generally used for enterprise engineering research. In research methodology approaches, most research studies defaulted using Classic grounded theory due to the limited guidance and examples using subjec-



tivist and constructivist approaches. Therefore, alternative approaches are called for in practical application of enterprise engineering frameworks. The use of research design approaches which allow for the participant to be part of the study can be applied thus not only having an objective stance.

Studies on the implementation of an enterprise engineering innovation life-cycle approach to deliver products that are value for money for business are limited. One of the more well-known methodologies is Design and Engineering Methodology for Organisations. Design and Engineering Methodology for Organisations is a methodology for understanding, designing, organising and linking organisations. Communication action is a central element in the execution and application of this methodology (Dietz, 2001). More detail about this methodology is given in the literature review section. Only a few academic articles have been published using the Design and Engineering Methodology for Organisations methodology in respect of a software development life cycle or an innovation life cycle. Design and Engineering Methodology for Organisations is an ontology-driven enterprise information systems engineering approach (Van Kervel, 2012). Van Kervel (2012) has used Design and Engineering Methodology for Organisations methodology in a research study to show that reusable methods can be applied to construct high-quality-based enterprise information systems.

There were a few shortcomings in this study (Van Kervel, 2012) using Design and Engineering Methodology for Organisations:

- First, it was very tightly coupled to an ontology approach making it compulsory for the enterprise to use the Design and Engineering Methodology for Organisations modelling and processing engine to build and execute enterprise systems.
- Secondly, the approach by Van Kervel (2012) did not take into consideration any of the socio-economic factors or challenges regarding why projects fail due to political, managerial, strategic or other technical reasons (Ahsan, Gunawan, 2010).

The purpose of this study is thus to explore an enterprise engineering innovation life-cycle approach through a case study to understand the challenges being faced while implementing



and using this innovation life cycle. The possible mitigating strategies can be put in place to overcome them. Previous studies have not shown the strategies that must be employed to overcome challenges when implementing an enterprise engineering innovation life-cycle. This study will also show strategies that have been executed while using a non-ontological approach which is not based upon the Design and Engineering Methodology for Organisations methodology. This study will also identify proposed factors that could have an impact on project performance.

This dissertation will address these challenges from an enterprise architecture management perspective using an Enterprise Engineering Framework as reference to (re) design, (re) engineer, and (re) implement an innovation life cycle in an organization.

1.2 Research objectives

Enterprise engineering is a very new field (de Vries, 2015) and needs further research to possibly close the gap between what the existing enterprise engineering theory offers and its usefulness in practice. Thus: the objective of this study is to explore an enterprise engineering innovation life-cycle which were based upon a mix of software development life cycle approaches through a case study to understand the strategies employed to implement an enterprise engineering innovation life-cycle and overcome related challenges.

First: This research will identify the factors influencing the use of an enterprise-engineering-based innovation life-cycle in a financial provider firm and the challenges that arise when following such an approach during the enterprise architecture governance processes. Secondly: It will also look at how the methodology was implemented and what the strategies are to overcome the challenges while using the methodology.



The research thus investigates two major areas: (1) innovation life cycle challenges, (2) innovation life cycle strategies, while applying the enterprise engineering concepts as part of the innovation life cycle implementation. The converge of the challenges across the phases of the innovation life-cycle and the strategies to overcome them are discussed first. Thereafter,

for each phase of the innovation life-cycle, the theoretical category presenting the strategy that will address the merged challenges is discussed first following by the breakdown of the challenges and strategies underneath it.

1.3 Research context

In the financial sector, IT initiatives should be client-centred and customer-focused. The delivery channels are complex due to the rapid proliferation of market challenges (Peppard, 2000). Limited research has been conducted around the challenges organisations faced in the financial sector when adopting an innovation life cycle (e.g. enterprise engineering innovation life-cycle) to deliver and meet the demands of business. These demands relate to the need for customer-centred financial products to create value for money as fast as possible (Christopher, M., 2000). Therefore, the study has been undertaken within a large South African company, within the financial sector, which recently adopted an enterprise engineering innovation life-cycle, customised especially for their purposes and requirements.

1.4 Research methodology

A single, in-depth case study of a large financial organization within South Africa will be conducted. The research will be done mainly in the Group Technology area of the organization utilizing an enterprise engineering innovation life-cycle. The research method adopted for this study is inductive and uses a qualitative methodology, called grounded theory. The reason is that the grounded theory methodology is recommended for situations where it is necessary to uncover and gather detailed explanations of how the research participants illustrate their real-life events and circumstances. Thereafter theoretical concepts that are grounded in or emerge from the data will be built. More details on the methodology is provided in Chapter 4.



1.5 Preliminary literature review

At the beginning of the research, a literature review was undertaken to understand and outline the existing studies already completed in this area. Thereafter identification of gaps in the literature that are needed to be addressed. The literature review on the research areas are described in Chapter 2 and the research methodology in Chapter 3. The literature review provides background on what an innovation life-cycle is and what enterprise engineering encompasses. The current generic building blocks upon which the innovation life-cycle is based will be explained. Thereafter an overview of what enterprise engineering is will be described at a high level giving context to the research phenomenon. In addition, some important aspects that differentiate an enterprise engineering approach from other similar methodologies or reference frameworks will become clear. The main purpose of doing a preliminary literature research was to establish a need for the research, to assist in formulating the research questions and to give theoretical background for readers unfamiliar with the topics under investigation. Another purpose of the literature review is to give context to the interview questions asked. This will form the basis of the initial set of questionnaires (see Appendix A). The study is following the constructivist grounded theory methodology that seeks to identify not only the core categories namely: challenges (Adolph et al., 2012) but also the strategies to overcome it. At the start and at the end of the preliminary literature review it was not yet known which strategies would be employed, as the challenges would only emerge after the execution of the research methodology had been completed. Further literature on the emergent core challenges and the strategies will be discussed in relation to the findings in the Discussion chapter, chapter 5.

1.6 Research Outcome

The main goal is to comprehend which strategies could be employed to overcome challenges when implementing an enterprise engineering innovation life-cycle (EEILC). Then to develop a theoretical model of the concepts that are connected to, grounded in or emerge from real life events and circumstances during implementation and optimization of the innovation life-cycle. These concepts relate to the challenges experienced when using EEILC within a large



financial provider organisation, as well as showing and explaining the mitigating strategies to overcome them.

1.7 Document Layout

The document layout structure is such to guide the reader from a brief literature review background to the conclusion. Guidance is achieved by presenting an overview of the findings first followed by the findings of each phase of the innovation life-cycle, thereafter a discussion follow with comparison from current literature.

Chapter 1 specifies the background, the research objectives, research context, research methodology, reasons for preliminary literature review, the research outcome and an overview of document layout. Chapter 2 presents a discussion of the existing literature in enterprise engineering as well as the use of enterprise engineering in the context of enterprise architecture management, IT governance, enterprise modelling and system development life cycle. Chapter 3 explains the research strategy, the research methodology that was followed for the research and the case study design details. Chapter 5 indicates the findings. Chapter 6 shows the results in a grounded theory approach. Chapter 7 concludes and summarizes the research outcome and places the research into perspective regarding possible future research.

The chapters are depicted each one with a chosen colour. Each chapter do have a graphical header show which chapter is current viewed, this aid in the logical flow of the document. Below is a short description of the content of each chapter.



Chapter 1 – Introduction

Chapter 1 contains the introductory sections of the thesis describing the motivation of the study, research objectives, research context, research methodology, motivation for preliminary literature review, research



outcome and an outline document flow to provide the reader guidance how to read the entire document.



Chapter 2 – Literature Review

Chapter 2 lays the foundational background for this thesis by first focussing on what innovation is, description of innovation life cycle and giving context what enterprise engineering based innovation life cycle is.



Chapter 3 – Research Methodology

Chapter 3 describes the research strategy approach, the research and case study design.



Chapter 4 – Findings

Chapter 4 contains all the findings gathered from data analysis. Deep descriptions are given for the concepts emerging from the interviews conducted. The findings are validated via data triangulation and method triangulation. Firstly, use of primary interviews is shown. Documents were received where research analysis had been done in isolation of this research study. Secondly informal conversational interviewing was used as well as formally reviews of the findings and results with research participants.



Chapter 5 – Discussion

Chapter 5 discusses the findings in more detail and uses literature re-



views to strengthen the findings and results.



Chapter 6 – Conclusion

Chapter 6 closes and completes this thesis with a summary of the findings, results and research outcome.



2 Literature review

The purpose of this chapter is to give a background of what innovation management is, what a generic innovation model is according literature to assist the researcher not to prescribe to a specific model outside of the case study and an overview of the innovation life-cycle used internally in the organization used as a case study. The literature review also covers the nature what an innovation life-cycle is and what the different building blocks comprise is considered. An ideal innovation reference model should be descriptive enough although it can result in too much detail to be applied in any industry domain. Strauss & Corbin (1998) argue that paucity of extant knowledge and justify the pursuit of Grounded Theory. Strauss & Corbin (1998, p.) states that, “*theoretical sensitivity, stimulation of key research questions, source of the research problem, provides clarity of thought, discovers contours of existing knowledgebase as to justify the need for Grounded Theory*”. Strauss & Corbin (1998) grounded theory method force the data into a framework and the researcher’s familiarity enhance sensitivity to subtle nuances in data. According Strauss & Corbin (1998) theoretical sensitivity is theoretical refinement by eliminating bias from literature review and the research outcome. Bias is avoided by not forcing a theory from data and by announcing the relationship between the researcher and researcher participants. Strauss & Corbin (1998) propose reflexivity on three levels social, theoretical and analytical sensitivity preclude.



2.1 Enterprise Engineering

Enterprise engineering is defined as the collection of information, facts, understanding, experience, know-how of standards and practices to design an enterprise (Giachetti, 2010). These resources interact with each other within and towards their environment to achieve common objectives and goals (de Vries, Gerber, & van der Merwe, 2014).

Per Pilkington (2008) enterprise engineering is related to many different domains, namely engineering management, operations management, service management and systems engineering. These fields are all interdisciplinary and are encompassed within the enterprise systems engineering (Giachetti, 2010). Enterprise engineering is a subfield of enterprise systems engineering (Dietz, 2006). Enterprise engineering contains all the understanding of and information on the best practices and principles of designing enterprise or integrating business components (Giachetti, 2010; de Vries, Gerber, & van der Merwe, 2014). Per Rebovich (2007), enterprise engineering principles and guidance are mostly used during phases of innovation and when an enterprise needs to have a multidisciplinary process of implementation or technology supporting the business processes.

Enterprise engineering is based on theories of ontology engineering, enterprise architecture, software engineering, information engineering and business engineering (Dietz, 2008; Swarz, & De Rosa, 2006). Per Martin (1995) there are themes of enterprise engineering including the interconnectedness between humans and technology; organisations must coordinate humans and their competencies (including knowledge and learning) with the technology used with the business strategy and business finances. He also claimed that business successes are dependent upon socio-technical issues and that organisational culture a driver.



Enterprise architects break down the enterprise into different viewpoints so that enterprise engineers and enterprise architects can analyse the enterprise from a business, technical and resource perspective (Frank, 2014). Like-wise on an end to end enterprise perspective, enterprise engineering frameworks provide guidance on how they could analyse a business (Dietz, 2008). The enterprise engineering approach undertaken to implement an innovation life-cycle in this research study is one of many approaches regarding the best practices, guidance and tools to be used during the enterprise engineering analysis and design. The following section describes the practical application of enterprise engineering principles in the context of enterprise architecture.

2.1 Theory of Enterprise Engineering

Per Dietz, *et al.* (2013), enterprise engineering has built the theories of three major fields namely: Philosophical theory, Ontological theories and Ideological theories. The following few paragraphs will briefly explain what each of these entails.

2.1.1 Theories of Enterprise Engineering – Philosophical Theory

Philosophical theories are theories that will explain the abstract concepts of what enterprise engineering is. It describes the nature of enterprise engineering and scope of the knowledge gained by the researcher as the interrogating questions of the “how” or “what” of enterprise engineering is answered (Strauss, & Corbin, 1998; Denzin, Lincoln, 2011). The principles of enterprise engineering and meaning of it is explored and their meanings will influence the perspective of the research as described by the knowledge gained by the researcher (Strauss, & Corbin, 1998; Denzin, & Lincoln, 2011).

2.1.2 Theories of Enterprise Engineering– Ontological theories

The semantic web as defined by Berners-Lee (2001) makes heavy usages of ontologies to describe how information and data are linked to each other and the meaning between them (Bizer et al., 2009). Using ontologies is therefore knowledge sharing and reuse across different application areas. According philosophy stance, ontology describes the nature of and the



structure of “reality.” (Øhrstrøm et al., 2005). According Gruber (1995), “An ontology is an explicit specification of a conceptualization” which means that an ontology is a high level abstracted description of the concept of something that do exist. Likewise, in a Ph.D. thesis, Alberts (1993) define “...An ontology for a body of knowledge concerning a task or domain describes a taxonomy of concepts for that task or domain that define the semantic interpretation of the knowledge...”, therefore ontological theories explain the relationships of entities observed in the phenomena. Enterprise engineering ontology described the nature of the enterprise and its dynamics between the things that cause the phenomena (Diet et al., 2013).

One of the main factors why projects fail according (Dietz, & Hoogervorst, 2008; Doucet et al, 2009) is because of the lack of alignment between business and IT strategy. To prevent misalignment there, need to be a common understanding of what an enterprise is, what it defines, how it functions, how the business processes drives the value chain all need to be communicated effectively, efficiently and unambiguously (Dietz, & Hoogervorst, 2008). The ontology need to well-defined the meaning what an enterprise is and its functions. Thereafter the enterprise strategy to achieve the enterprise objectives and goals, driven and supported by information systems need to be defined as well. This is the means how business and IT alignment are supported by an enterprise engineering approach, defining an enterprise ontology for use by enterprise architecture and enterprise governance (Niemann. 2006; De Haes, & Van Grembergen, 2015). The next sub field, enterprise architecture will be discussed briefly to describe the purpose of enterprise architecture in an organization.

2.1.3 Theories of Enterprise Engineering– Ideological theories

Ideological theories are theories that addresses the beliefs that motivates people to people strive to goals. In the context of an enterprise it is the motivations that drive people to achieve the enterprise goals and objectives (give references). To achieve these goals there, need to be a common understanding of those beliefs and values in an organization. This makes it possible to define a common understanding of the enterprise goals as well as the enterprise architecture objectives and purpose (Boucharas et al., 2010).



2.1.4 Theories of Enterprise Engineering– Technological theories

According Dusek (2006) there are various philosophical approaches that can be applied for different tasks investigating the philosophy of technology in context of research. There are so many views to name a view would be logical views, economic views, and analytical views these can be approached in context of the society and culture.

To describe the basic roots of technology theory one can look at the different types of technological theories (Bunge, 1967) namely substantive and operative. “...Substantive technological theories are essentially applications, to near real situations...” (Bunge, 1967:122). Substantive theories are the engineering sciences and are the applied sciences of engineering theory. Operative technological theories are the theories that do describe the human and technological dynamics in real situations. In the context of this thesis operative theory would be the theory of how the technology affects people and how people uses and drives technology changes. According (Dietz, 2008; Dietz & Hoogervorst, 2017) this theory describes the whole development process of a system, consisting function design, construction design and implementation. The theory of enterprise architecture is an example of an application of the theory of enterprise engineering (Dietz & Hoogervorst, 2017).

2.1.5 Enterprise Architecture

The application of defined enterprise engineering principles (Op't Land & Proper, 2007; Dietz & Hoogervorst, 2012) assist with the enablement of IT to realize value for business. The enablement of IT, can only come through enterprise architecture (EA) governance of business processes and IT processes in an organization. Enterprise architecture governance enable both business and IT to perform their tasks and responsibilities to for fill both the business and IT strategies creating the value chain for the company (Op't Land et al., 2008). The enterprise architecture governance model guides the planning, development, enablement of product and service through capability management (Dietz et al, 2013) of business capabilities and supportive enabling technical capabilities using policies, best practices, principles,



patterns and procedures and business processes but also the organizational changes that will affect the employees. To achieve this, goal a unified and integrated approach between the enterprise business context and the IT context is needed to ensure synergies of alignment between business and IT strategies (Dietz et al, 2013). Enterprise modelling support decision making to keep business and IT strategies aligned. Enterprise models depict the business processes of the enterprise together with semantic models of the IT landscape in current and future strategic state.

2.1.6 Enterprise Modelling

To model these an enterprise engineering approach could be followed as proposed by an enterprise engineering contextual model (EECM) by de Vries, Gerber & Van Der Merwe (2014). An enterprise engineering contextual model (EECM) was inductively established by de Vries, Gerber & Van Der Merwe (2014) by looking at existing enterprise design, enterprise alignment and enterprise governance approaches. The EECM therefore presents a high-level meta-model for the existing body of knowledge within EE. EECM serves as a common reference model to put existing enterprise engineering approaches into perspective with each other (De Vries, 2010; De Vries, 2012; De Vries, Gerber, Van Der Merwe, 2013) by deriving a context model that do describe common properties of enterprise engineering.

Various enterprise modelling methods and techniques can be applied showing the enterprise ontology of the enterprise together with the enterprise architecture ontology, describing the IT landscape (Dietz et al, 2013; Dietz & Hoogervorst, 2017). Collectively these models are used to make informed decisions on the AS-IS vs TO-BE capability models and architecture roadmaps (Fritsche & Pigneur, 2015; Furterer, 2015). The dynamics of the capabilities are and the need to model those are proposed by Danesh et al (2015). Dynamic capabilities enable enterprises to foster innovation, have a competitive advantage in the marketplace (Teecy, 2007; Teece, 2017; Zhou & Wu, 2010) and to increase in performance (Zhou et al., 2017) which are one of the drivers of innovation (Teece, 2007).



2.2 Defining Innovation

There are different scholarly views on innovation. Historically, innovation management was defined by Schumpeter (1939) and enhanced by Drucker (1985) adding that innovation can happen within an organization's entrepreneurial business activities.

Innovation do have different perspectives, a thorough content and attribute analysis was completed by Baregheh, Rowley, & Sambrook, (2009). They do describe innovation with multiple facets drawn from engineering, science, technology, management and economics. Creativity and the idea generation support innovations (Storey and Salaman, 2005). The generation of ideas happen before invention. Invention is the creation from the idea into the product or service (Crossan, & Apaydin, 2010) via the innovation process but not yet into the market. Whereas innovation is the development of that idea into an invention for commercialization purposes until it is released into the market (Fontana, Musa, 2017).

Voeten, et al. (2011, p98) describes innovation as:

“The introduction of new or improved products, production techniques and organisation structures, as well as the discovery of new markets and the use of new input factors.”

Innovation can be defined in terms of the type of innovation that occurs in market situations (Damanpour, 1991; Baregheh, et al., 2009; Booysen, 2010).

2.3 Generic Innovation Types

Zahra, & Covin, (1994) describe innovation as dealing with the creation, development, and application of ideas into a concept or patent which is then designed and developed into a new product, service, system or process and technological. This was strengthened by a study by Baregheh, et. al. (2009).



The different types of innovation will be described below as follows:

- *Product innovation*: According Popadiuk, & Choo, (2006) it is to create new or changed products that will give an organization a competitive advantage in an existing or new market segment in addition to the current products the organization has.
- *Process innovation* is a new technique to produce or distribute new products or services implemented. This for example is the use of robots to build and assemble toys automatically instead of using hand labour doing the same task or activity. Hereby, improving the efficiency, referring to reducing the cost of labour, and improving effectiveness, meaning to improve the outcome to produce higher quality products and services quicker (Marais, 2010; Katz, Du Preez, & Schutte, 2010). This will improve an organization's capability to deliver better quality products and services, decrease the time to commercialize products and services to the market and have better after-sales support for products and services provided (Katz, Du Preez, & Schutte, 2010).
- *Service innovation* is to combine a new product with a new process so that the product offered is channelled or processed differently or more efficiently than before. Service innovation also provides services in a new or enhanced way.
- *Technology innovation* is when a new product or services or new processes affects the technical system of an organization and the technical system's physical hardware or software is used to change or create new products from raw materials into product or services (Subramanian, & Nilakanta, 1996).

Traditionally, innovations were depicted as visible products or services but now innovations are more complex and encompass physical and non-physical in nature which are not always visible. For example: organizational innovations or financial innovations are also innovations. (Baregheh, Rowley & Sambrook, 2009).



2.4 Domain Specific Innovation Types

More and more disruptive innovation types occur describing domain specific innovation i.e. Marketing innovation (Epetimehin, 2011) or Banking innovation () and innovation types that occur due to a combination of specific domains i.e. financial technology innovation (Fintech).

Katz et. al., (2010) has reintroduced the importance that innovation can also be a strategic. Market innovation as described by Foxall, (1984) and the impact of market innovation creativity can deliver in a competitive advantage by Epetimehin, (2011). Organizational innovation was described as administrative innovation by Teece, (1980). The term administrative innovation was defined as a type of organizational innovation by Azar, & Ciabuschi, (2017) due to the dynamics of how organizations function and performance has grown over the years since 1980.

Table 2-1: Innovation Types

Strategic innovation	Was first introducing by (Hamel, 1996, Hamel, 2006) as “Business concept innovation” which is described as changing the business model of an organization as such to give a company a competitive advantage (Katz, et. al., 2010) with regards to products and services rendered or process optimization or utilizing technology. Therefore, strategic innovation occurs when an organization changes strategic direction or positions itself in the market place in such a way that the organization will have a competitive advantage over its competitors (Katz, et. al., 2010).
Organizational innovation	Kasemsap, (2017) includes administrative innovation when an organization radically changes its structure and administrative process (Popadiuk



	and Choo, 2006) to be competitive in the market place.
<i>Marketing innovation</i>	Involves a new marketing method or technique to position and commercialize a product in the market place (Epetimehin, 2011).
<i>Architectural innovation</i>	Is when both the technological and market capability within an organization needs to change radially and at the same time to be competitive (Christensen, 1992; Popadiuk, & Choo, 2006).
<i>Social innovation</i>	Is due to the social interactions as the need for a specific product or services or a process are to be created (Nicholls, A., & Murdock, A., 2012). Social Innovation is also the interactive collaborative activities between actors creating the need for products or services or processes.
<i>Financial Services Technology innovation (FinTech)</i>	Arner, Barberis, & Buckley, (2015) describes “FinTech” as “ <i>technology enabled financial solutions</i> ” or “ <i>the use of technology to deliver financial solutions</i> ”. It is therefore the combination of financial services and information technology.

The concept of innovation has become much broader than before. Moreover, many innovations are combinations of technical changes and non-technical changes. FinTech has changed the way financial service providers must do business, prompting them for more innovative solutions to stay competitive in rapid changing marketplace. For instance, for developing branch-less banking solution providing banking products and services, a combination of innovation initiatives needs to happen namely strategically, product, service, process, organizational and marketing innovation (Romănova, & Kudinska, 2016).



2.5 Degree of Innovation

Innovation can also be described in the degree of innovation occurs as one of transformational or radical or incremental. When innovation causes changes in society that is of disruptive nature so much so that it impacts the way we live that is called transformational innovation. Such an example is the use of internet for online shopping or the introduction of cell phones use instead of landline phones. Radical changes occur such as the use of mobile phones or incremental ones such as the introduction of airbags in cars. Therefore, product, process, service, technological and strategic innovations can change market situations in a transformational, radical, or incremental way.

The consequence of innovations that are combined i.e. Fintech, triggering developing innovations has become much more complex, since often different changes (both technical and non-technical) are necessary to stay competitive in the marketplace. The complexity of innovation has been researched and proposed by wide spectrum of process models. A summary of a basic innovation process model will be described in section 2.4.

2.6 The role of Innovation

Baregheh, Rowley, & Sambrook, (2009) note that "Organizations need to innovate in response to changing customer demands and lifestyles and to capitalize on opportunities offered by technology and changing marketplaces, structures and dynamics". Due to the fast-changing customer demand and advancement of technology, companies are forced to be innovative resulting in better products and services in a quicker turn-around time to stay competitive (van Zyl, 2006). Companies must use innovative technology solutions to attract and retain customers converting them into loyal long-term relationship customers (Entertainment, P. 2010; Sheu, Chu & Wang, 2017).

Competitive companies need to grow to meet customer demands. Accordingly, (Nidumolu, Prahalad, & Rangaswami, 2009) innovation is needed to have a competitive advantage in the market place. Price Waterhouse Coopers (PWC) reports there is a clear correlation between



innovation and growth. A five-year study by PWC with 1757 companies shows that the Top 20 most innovative companies show a growth of at least 16% or higher than the other companies even up to twice the growth pace of the global average of 35.4% (Entertainment, P. 2010; Sheu et. al., 2017)).

The role of innovation enables companies to grow and keep customers in the long-term Camisón, & Villar-López, (2014). An innovation benchmark study by PWC (2017) indicates that 69% of companies' executives believe that sales growth is the most important measure to determine if innovation was successful. The result whether that customer demand was met is only secondary.

Innovation adds value to products and services offered to customers by providing giving them complementary assets and capabilities which could prevent customers to take their business to rivals in the market place (Sachdeva, 2016). Innovation is not just a key aspect to survive in the marketplace but a necessity (Morente, & Ferràs, 2017). Innovation is the cause for organizations to have short-term and long-term sustainable growth (Hogan & Coote, 2014) providing a key element helping organizations to be successful (Crane and Meyer, 2011; Bessant, Von Stamm, B. & Moeslein, 2011). Innovation also adds value by introducing new knowledge into an organization pushing technology as an enabler forward (Chesbrough, 2004). This gives organizations a competitive advantage in the marketplace (Vila, Pérez & Coll-Serrano, 2014) to meet the market needs.

2.7 Innovation management

A study by (Morente, & Ferràs, 2017) shows that innovation management is dynamic and volatile and must materialize innovation opportunities. Innovation management is a set of management strategies that assist in the introducing of innovative products or services using innovation processes and activities employing resources (Crossan & Apaydin, 2010) to a competitive advantage above competitors in the market place (Trott, 2008; Crossan & Apaydin, 2010).



An Innovation management framework for product service system (PSS) was proposed by Song, Ming, Han, Xu, & Wu, (2015) to address shortcomings in current innovation management frameworks focussing mostly on the design and development domains rather than on a systematic method to manage the innovation process to provide guidance to implement product service system successfully. The framework proposed three levels of management, first strategic management decisions are made to determine how in an organization strategic objectives and goals work in context of PSS. This has the organization's business model adjusted to be innovative and deliver a product and services of value to the client. The second level of management decision making is purely tactical making sure that PSS requirements are defined and to convert requirements into design specifications using collaboratively concept development, implement PSS prototype using resources and having PSS support for the implemented product. The third level of management is to support the product with customer-activity-based requirement analysis, managing resources to minimize cost making sure the final product is aligned what the market demands.

Another aspect of innovation management is the management of technology to support innovation capability within an organization (Johnston, & Marshall, 2016;

Nambisan, Lyytinen, Majchrzak, & Song, (2017). The understanding of technology as a corporate resource has led to the emergence of the management of technology as a new discipline (Dodgson, Gann, & Salter, 2008). Technology management is studied as a corporate resource that determines both the strategic and operational capabilities of the firm (Zhou, & Wu, 2010).

This will create the capacity within an organization to be innovative. Therefore, innovation starts with strategy. Companies need an innovation strategy for management in innovation capability (Goffin, and Mitchell, 2010). Different types of innovation must be positioned within the organization by executing the correct strategies. Each innovation type will have a different strategy within the organization. The correct resources must be allocated to each innovation type (Katz, 2007).



2.8 Innovation Process Models

Looking at innovation processes depicting the innovation life-cycle will direct the research study into the construction of the interview questions, the summarization of the findings and the results. A generic innovation life-cycle was described by (van Zyl, 2006) and shown in figure 2.1 (van Zyl, 2006). An innovation life-cycle (van Zyl, 2006) could be presented by the following phases: invention, feasibility, implementation, operation, and final disposal (van Zyl, 2006).

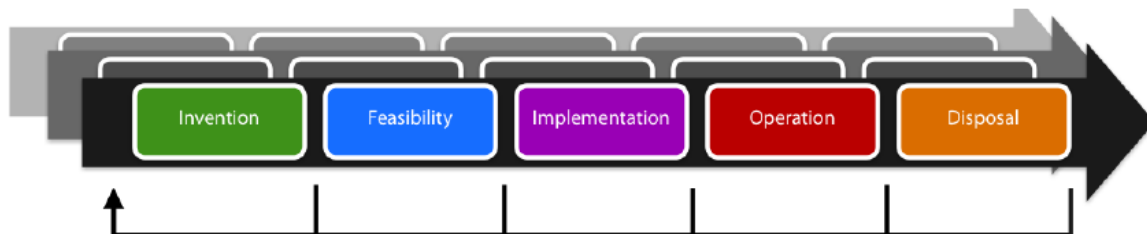


Figure 2-1 Basic Innovation Life-Cycle (van Zyl, 2006)

The five phases identified are:

1. Invention: The invention phase is where creativity takes place and ideas are changed into opportunities.
2. Feasibility: In the feasibility phase the ideas and the opportunities are evaluated to be feasible to be successful by doing market research, preliminarily design, specification development and functional analysis and testing of the concept and ideas.
3. Implementation: The implementation phase builds upon the feasibility phase, adds more knowledge and detail to the initial design specifications and actual development of the product or services.
4. Operation: The actual product or service or processes or technology is commercialized into the organization's operation and monitored via quality control to optimise the innovation.



5. Disposal: The disposal phase is when the innovation life-cycle fulfils the desired application of the innovation and marks the closure of the initiative and the product or service will move into sustainability or further research to optimize what has been implemented.

Financial services have traditionally followed a new product development (NPD) innovation life-cycle based upon the stage/gate model (Cooper, 2008).

2.9 Product Life-Cycle Innovation process

The author gained access to an internal document depicting the innovation life-cycle (Louw, 2010a) that the organization used while the study was being conducted. The internal innovation life-cycle was designed internally and was based upon the use of the life cycle phases of Generalized Enterprise Reference Architecture and Methodology (GERAM) as proposed by ISO/IEC (2005), Noran, (2003), Saha, (2007), Bernus, Nemes, & Schmidt, (2012). This encompass the use of ISO ISO15704's requirements for enterprise-reference architectures and methodologies, Department of Defence (DoDAF)'s different viewpoints DoD Architecture Framework Working Group. (2009), a used case model driven design methodology (Kruchten, 2004) and tool-set integration of Rational Unified Process (RUP), decision check points (DSP) as described by Hole, Verma, Jain, Vitale, & Popick, (2005) and systems engineering life-cycle high level processes from International Council on Systems Engineering. (2011). A high-level overview of the standard system development life cycle phases mapped using the GERAM life cycle phases (Noran, 2005; Bernus, & Noran, 2010) with the quality gates that govern the quality of the deliverables between phases is depicted in figure 2.2. A mapping between the generic innovation life-cycle and GERAM is shown in appendix F (Louw, 2013; Louw. The life cycle phases are very analogous to the generic basic innovation life-cycle from van Zyl (2006). After idea generation and concept design are completed the GERAM-based innovation life cycle had a business requirement review (BRR) quality gate to ensure the high-level requirements were reviewed before a preliminary design was completed. After the high-level design and the detail requirements are reviewed at solution requirements review (SRR), the approval for funding to commercialize the innovated product or service or process under execution happen. During execution of commercialization the product or service or process is further developed and tested. The detail design phase was split in two steps, macro and micro design. After macro design a preliminary design review (PRR) was held



whereupon the micro design was to commence. Then after critical design review (CDR) the development would start. The building of the product would be evaluated for test readiness review (TRR) to make sure the infrastructure, the test environment and test cases were ready before testing. After testing a production readiness review (PRR) would ensure that all test cases were completed with an acceptable measure of quality. Once the product was in the market place the product would be monitored to harvest information to gather statistics determining the value and benefits the client and the organization has gained.

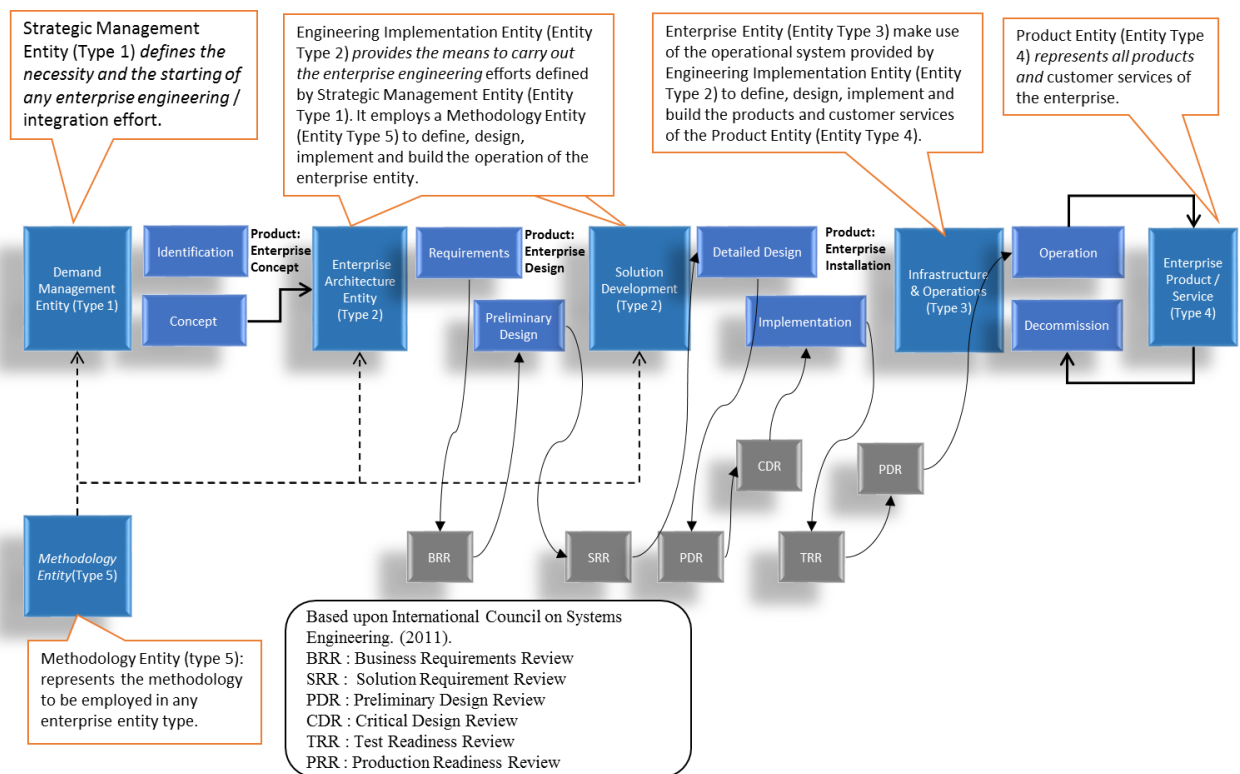


Figure 2-2 Generic Product Innovation Life-cycle with GERAM (ISO/IEC, 2005) phases and quality gates (International Council on Systems Engineering, 2011) adapted by Louw (2010a)

As seen on the diagram the stage/gate life cycle innovation life cycle of Cooper (1990) is very similar but does not have finer inner quality gates splitting the detail design in two steps as in figure 2.2 with PDR and CDR. The same with TRR and PRR, there are additional quality gates for testing before implementation could happen.



2.10 Enterprise Engineering Innovation Life Cycle

The innovation life-cycle is utilized in an enterprise and does not stand on its own. It was mentioned above that the “internal” innovation life-cycle is based upon an enterprise engineering reference framework, GERAM. The reference framework only provides guidance with no specific prescriptive way as to how each life cycle phase and entity type could be used. It is an open reference framework where the implementing designer chooses entities as seen fit according the enterprise requirements and then apply them to design the innovation life-cycle. Therefore, an Enterprise Engineering Innovation Life Cycle is an Innovation Life Cycle where upon enterprise engineering design paradigm had been applied to design and implement.

To provide a better understanding as to what Enterprise Engineering is, a definition from Liles et al., (1995) for enterprise engineering is quoted as, “*that body of knowledge, principles, and practices having to do with the analysis, design, implementation and operation of an enterprise*”.

2.11 The innovation life cycle research so far

Limited research has been completed that could provide a formal theoretical grounding of applying enterprise engineering in context of an innovation life-cycle. The theory of innovation life-cycle have been discussed by (van Zyl, 2006; Krause, Schutte, & Du Preez, 2012) but neither the enterprise engineering context nor the strategies provided what was needed to be applied to overcome challenges when implementing or optimizing an innovation life-cycle.



However, research by De Vries et al. (2014) and De Vries et al. (2015) provided a practical guide and frame of reference for EA practitioners to develop enterprise engineering processes and maintain an enterprise architecture capability within an organisation. Their findings revealed the conceptual components that described the architecture from different viewpoints and provided guidelines on how to align architectural capabilities per the demand of business.

2.12 Chapter Summary

Although grounded theory approach is chosen for this research study, it is standard expectation from those that supervised this research study, that as part of the research proposal, a literature review was conducted to show that the researcher does have familiarity of existing literature, to position the research objectives and research question against existing knowledge. The literature review re innovation, a description of innovation life cycle and the enterprise engineering aspects applied to the innovation life cycle. It was explained that an enterprise engineering innovation life cycle approach could be undertaken and what was needed to manage and improve its implementation. The different types of innovation were listed. First the most generic ones e.g. product, process, service and technology and secondly domain specific ones like strategy, marketing, organizational and financial service innovation. This set the scene for the findings of the research. The researcher decided to use the internal generic innovation life-cycle of the organization as the case study, on a basis to draft the semi-structured interview questions regarding the life cycle closely resembling the basic innovation life-cycle summarized by van Zyl (2006). Thereafter as the interviews became more open-ended the basic innovation life-cycle van Zyl (2006) was referred to in the questions to prompt generic insight and answers from the interviewees.



3

Research methodology

Building upon the foundations positioned by the background literature review about what innovation is, the basic innovation life cycle and enterprise engineering based innovation life cycle, this chapter describes the research strategy which describe the approach that were followed by researcher and then going deeper explain the research methodology that will be followed during this research study.

First, the research purpose and research questions are articulated to give substance and context to the research. This is followed by a discussion the researcher's ontological research position. Thereafter the research concludes with the reasons why a constructivist grounded theory (Charmaz, 2014) approach was followed.

Detailed description is also given how the application of research methodology, the flow of the interviews conducted and the data analysis that followed. Brief description is given how the findings were validated. More detail is also discussed at the end of the findings chapter, Chapter 4.

Due to enterprise engineering is a new field in engineering and management there are a continual research been done to improve and apply research methods that are appropriate for this domain (Molnar, & Korhonen, 2014; Pluijmert, Molnar, & Proper, 2013; Gaaloul, & Molnar, 2014).



3.1 Research purpose and research questions

Primarily the aim of the research project was to develop a theory, particularly by using the grounded theory approach. Based upon the literature review, the following research questions and objectives were obtained.

3.1.1 Primary research question

Which strategies could be employed to implement an Enterprise Engineering Innovation Life Cycle (EEILC), to overcome related challenges?

3.1.2 Secondary research questions

- (1) What are the challenges experienced by various role players while using an EEILC?
- (2) How are proposed strategies employed to address the EEILC challenges?

Before the researcher explains the reason for the choice of research paradigm, a section will follow to explain the researcher's ontological research position, the epistemological perspective, in other words how the researcher took a stance regarding reality, objectivity and constructivism.

3.2 The researcher ontological research position

The ontological research position is a description of the researcher's assumptions and position towards the fundamental existence of nature and how the researcher sees what the world is made up of and the nature of things (Bunniss, Kelly, 2010).

The researcher believes that reality is socially constructed (Mertens, 2005; Tuli, 2011). Therefore, the researcher does not believe that social phenomena exist separately from their associated meanings as described from their actors. Also, belief that the social phenomena and their meanings are continually changing as constructed by the actors. These are in a constant changing state created by, influenced by the actors (Charmaz, 2006).



3.3 The researcher epistemological research position

Epistemology is derived from the Greek words ‘episteme’ and ‘logos’. ‘Episteme’ means knowledge and ‘logos’ mean reason (Hintikka, 2012). Epistemology is how knowledge is gathered and the reason to create new theoretical models or to change existing theoretical models. The researcher believes that the knowledge gathering can change over time and open many avenues and processes to do so.

The researcher does not believe that one can establish a regular relationship between social phenomena only by just by using theory, but that it is a dichotomy between what we see and how things really are (Latour, 2003; Grix, 2010; Ward, 2011; Picard & Lowe, 2016). Social phenomena and social worlds have value systems that are not value-neutral (Cunningham & Allen, 2010). In a social world research actors are not only objects but participants in sharing and creating knowledge, the social world is therefore socially constructed. To understand phenomena one cannot only rely on objectivity because the social phenomena do not exist without our (and their) interpretations of the actors (Charmaz, 2006; Goldkuhl, 2012; Mertens, 2014 and Tuli, (2011).

3.4 Constructivism perspective of knowledge

Charmaz explains that constructivists believe that the researcher is subjective towards the social phenomena and the research participants’ own experiences, their views and the researchers’ interpretations. These together form “constructions of reality, research participants’ implicit meanings and researchers’ finished grounded theories are both constructions of reality”, (Charmaz, 2006, p10). Knowledge therefore does not exist independently of the research actors nor the interpretations of them. The research actors are essentially part of the social reality of being researched and are not separate. The emphasis is on understanding the meanings of the social phenomena (Charmaz, 2006). The study follow an interpretive perspective as described by Charmaz (2006).



The grounded theory process as explained in Charmaz (2006, p11) is summarised in Figure 3.1 below. The aim of the grounded theory methodology is to explain phenomena based upon empirical data (Charmaz, 2006).

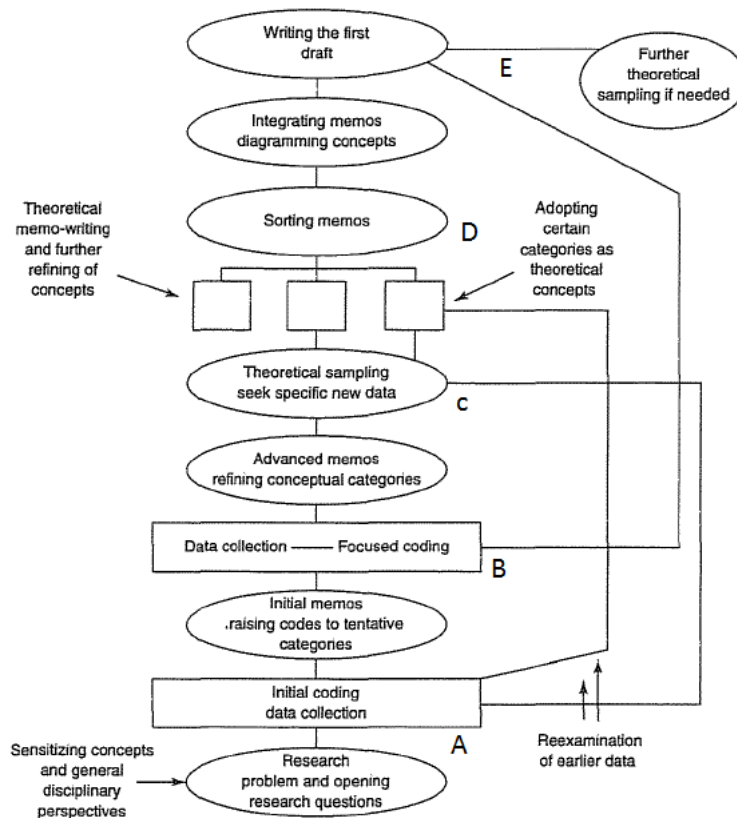


Figure 3-3 - The constructivist grounded theory method (Charmaz, 2006)

The research process will follow as described by Charmaz (2006) but with the generic diagram in Figure 3.1 as referenced from step A to E.

A) After the researcher determined the case and the initial sample, the researcher begins collecting the data. Once the first sample of data is harvested, the researcher analyses the data and does initial coding.

B) Thereafter a conceptualisation follows called focused coding. These concepts are the building blocks of the theoretical categories.

C) For the theory to emerge from the data, during the data analysis, a constant comparison method between concepts and memos follows to give insight to the researcher



to decide what data to collect next and where to find the data, this is called theoretical sampling.

D) During the whole process researcher writes memos and they are kept during the research process and write down ideas or new concepts or categories or new relationships that could have occurred or any gaps that must still be investigated. After every time the researcher has coded the data, a constant comparison with previous data sets is done. Categories and concepts are built and grown until a network of interrelationships between the categories reaches a saturation point. That means no more additional properties or concepts emerged.

E) After saturation, the theoretical model may be compared with other models in literature but not necessarily (Charmaz, 2014).

3.5 Grounded theory process

The main aim of the grounded theory process is collecting data, analysing the data to construct theories that are grounded, in other words “founded” or “emerged from” the data and the research context (Charmaz, 2014).

The process is started by collecting data from a wide range of methods. It could be any one of or a combination of interviews, observations, focus group discussions, documents, video or audio material. The raw data is analysed, coded and sorted using qualitative coding mechanisms. During the coding the researcher will constantly and interactively compare the previous codes founded, that have merged before and currently, with field notes and memos until a saturation point has been reached. The whole coding process leads to a categorisation of the coded data, which will form the theoretical model (Charmaz, 2006). This research is done at a very high level, an abstracted view of the phenomenon under scope of study. In the next section, a few key assumptions of this study are listed, which explains the constraints of the scope of the research.



3.6 Research approach – constructivist grounded theory

The research will follow an inductive approach as described by Charmaz (2014). An inductive approach allows the researcher to identify patterns emerging from the data. The patterns that occur relating to the research question will emerge in the context of real-life experiences of people Strauss & Corbin (1990). The theory that will be developed will explain the patterns that occur. Therefore, the researcher will move from a set of observations and interviews and inductively move from those experiences the people explained, to a more general set of propositions about those experiences. Per Simmons (2006), a grounded theory avoids making assumptions by the researcher and is good for determining real-life experiences.

The main difference between following a constructivist grounded theory approach versus the classical grounded theory approach is in the instance where the approach of the researcher is as the participants' partner contrasting in the latter only as an objective analyst of subjects' experiences (Mills, Bonner, & Francis, 2006). The researcher following a constructivist grounded theory approach also needs to critically reflect upon the researcher's underlying assumptions of knowledge gained, knowledge shared and be aware to listen to participants' stories and experiences. According (Mills, Bonner, & Francis, 2006), the researcher should depict interactions with the research participants, data analysis and findings in such a way so that it is meaningful for those in the field.

The constructivist grounded theory methodology is therefore well-suited to understand the phenomena where the researcher is also knowledgeable and involved in the uncovering of the theory together with the participants and not solely an observer (Charmaz, 2014).

3.7 Sampling

The sampling technique for grounded theory differs from quantitative studies, whereas the researcher will use the research questions and research strategy to sample the site, case and research participants (Ritchie, 2013). There are two types of sampling techniques for grounded theory, they are: i) purposive sampling and ii) theoretical sampling (Dalal,



2016). Both purposive sampling and theoretical sampling techniques were used in this research study. The former to recruit research participants who could provide rich information and the latter to get further insights into the data as the process continues until the saturation point has been reached.

3.7.1 Purposive sampling

The purposive sampling method is a method to get samples without statistical means or a scientific method (Dalal, 2016). Grounded theory methodology allows for purposive sampling, which allows the researcher to selectively choose the best case based upon the research objectives, choose the best site and choose the best participants based upon the researcher's own judgement. The case organization was chosen based upon the research interest in innovation life-cycle and the researcher's work environment was going into a change management process implementing an innovation life-cycle. Research participants were chosen based upon the knowledge the researcher gained by utilising the specific enterprise engineering innovation life-cycle (EEILC) for four years. In the beginning when the innovation life cycle was introduced into the organisation, the researcher did have the privilege to meet the inventor/implementer/mentor of the innovation life cycle. Therefore, this person was the first research participant for interviewing. The reason was that a wealth of knowledge and facts could be harvested right at the beginning of the process and thereafter branched out in different directions of thought as the ideas and the experiences were shared. The key research participant pointed the researcher towards the next participants who would provide the key information searched for. This also enabled the researcher to identify the best key research participants for the study by reference by the interviewee that was a mentor in this domain. This ensured obtaining diverse perspectives of the social phenomenon. A wide spectrum of challenges faced him when implementing the innovation life cycle. This was shared by enterprise architects, business architects, integration architects, data architects, solution architects, infrastructure architects, senior multi-skilled developers, senior system analysts, testers, executives, senior management, business analysts and project managers.



3.7.2 Theoretical sampling

Grounded theory is an induction process where the data is collected, interviews are transcribed immediately, the data is analysed, coded and categorised until saturation point has been reached. This sampling is theoretically orientated as it gives guidance towards the next “step” of the process, which can be one of many options, depending upon what the constant comparison process reveals or gives direction to. During analysis, a new data with new categories has been added with new codes if saturation point has not yet been reached. Additional data collection could take place or if a saturation point has been reached then the grounded theory process is finalised, where after the findings and discussion of the research study are written.

3.7.3 Data collection

The grounded theory method may use data obtained from many sources, like surveys, interviews, secondary documents and literature (Charmaz, 2014). This study looked at ways to get the best data available for this study whether via interviews or documents or observations. Due to some participants, not being available for the interview, requests were sent out via email to ascertain whether they had any supplementary or secondary documents that would support this research study. The data collection purpose was to identify sources of data that would help the researcher identify challenges that occurred (and could still occur) while using an enterprise engineering innovation life-cycle (EEILC). It also assisted the researcher in getting to know and fully understand the strategies that were employed to overcome those challenges. This study will use data obtained from primarily from formal interviews, documents and observation. One focus group discussion was held where the researcher was more of an observer listening how the group address challenges in the innovation life-cycle in the scope of the project the participants were employed in.



3.7.4 Case Study - Overview

A case study is used in this study to describe the specific time, place and context of the research. This case study purpose is just there to set the boundaries of the research (Savin-Baden, & Major, 2013).

The chapter provides a description of the case study, the business units in the enterprise and highlights the boundaries for this research study, the different departmental teams and the distinctive role and purpose of each one. Contextual information related to each one is given so that the scene is set for the forthcoming research analysis and findings. To provide a holistic perspective on this study, various teams were chosen to fill any possible gaps that could result from getting data from one team only. Each team that used the innovation life cycle could be logically seen as part of one group that used the innovation life cycle regardless of whether the teams were physically separated. It was not possible due to the scope of this study to interview all employees in each department therefore representatives who are the most knowledgeable were identified. The data gathered from each interviewee, was a representation of the experiences by others in the same group as well. No distinction was made if a stakeholder were in another category. All input and feedback were part of one social system with many interactions where the realities of the collective make up the reality that we saw and experienced presently, but which could change at any time. This also aligned with the purpose of the study to get an enterprise engineering perspective and not only a single perspective of innovation life cycle implementation. Multiple-team feedbacks are often preferable to single departments, particularly when a researcher would not get a wide enough sample size to cover the breath of the research study that had to be representative of the population from which the research findings would be drawn and when different behaviours, experiences, situations could occur during the phenomenon under study.



3.7.1 Case study – Applicability

The reason why this organization was used is that the approach in implementing an innovation life-cycle is unique based it on enterprise engineering framework. The context of the study was done in South Africa and the researcher have access to experts in the field with 20 or more years' experience covering all domains of the innovation life-cycle.

3.7.2 Case study - Introduction to and history of Organisation X

Organisation X is a South African financial provider that has grown since it was initially established in the early 1900s. Hereafter it grew not only in the Retail banking sector but also acquired Corporate Investment Banking, Private Wealth and Capital banking subsidiaries. It was listed on the Johannesburg Stock Exchange (JSE) in 1969 and has also expanded its market share in the rest of Africa and in Europe. This has been achieved through alliances and by offering clients opportunities of investing locally and internationally. In the rest of Africa Organisation X has established branches in Malawi, Lesotho, Mozambique, Namibia, Zimbabwe and Angola and Kenya. It continues to grow in the African market and is established as one of Africa's most respected banks. With its close alliances with other banks, organisation X has the largest network of branches in Africa across 39 countries (about 2000).

3.7.3 The role of IT within Organisation X

In Organisation X, business sees IT as an enabler to support its operations. IT is responsible for Organisation X's processing of transactions, data, and information, and all business activities. The development and support of IT systems enable business to respond rapidly to market changes.

The IT cluster is called Group Technology, which encompasses all IT functions' design and development of IT solutions, specifically tailored for business, infrastructure and maintenance. The IT cluster also engages with vendors providing bespoke solutions, which then work as implementation partners enabling IT capabilities supporting business objectives and market strategy.



There are four major business units within the Group Technology cluster, Enterprise Architecture (EA), Application Design and Management (ADM), Infrastructure and Operations (I&O) and Programme and Project Management (PPM). Each one of the business units has a specific function. The EA business unit ensures business demand for IT capabilities to support and enable its strategy per the demand management function. The ADM business unit is responsible for the implementation of IT applications and infrastructure solutions as agreed by the EA business unit. The PPM business unit manages all the IT projects regardless of size per agreed business funding and timelines. The Infrastructure and Operations (I&O) business unit looks after the maintenance of existing IT applications and infrastructure capacity for business operations to run smoothly.

3.7.4 Case study – research participants

About 30 interviews were conducted during this study (4 initial interviews, thereafter 26 additional interviews were sampled during theoretical sampling until saturation point was reached to cover specific domain areas, given the vastness of the specific departments using the innovation life-cycle. This total of 30 interviews were interviewed across all disciplines, two executives and one lead architect/consultant from Enterprise Architecture, two executives and three multi-skill specialists from Application Design and Development, one process engineer from Project Management Design Analysis, one from Business Analysis from Business support, one from Tool support and one from finance. Each participant represents a group of stakeholders, ranging from small to very large department size (see table 3.1 below). In some cases, more than one participant was interviewed depends upon if saturation point were reached during interviews. During and after interviews participants have pointed the researcher in the right direction whom to interview next to harvest more in depth information. As the interviews were conducted each one was transcribed and memos were written and compared with the field notes and the codes and concepts already uncovered.



Table 3-1 Demographic data summary

Interview no.	Department	Team/Group	Department size	Roles	Participant
1	Enterprise architecture	Enterprise governance	5	Lead Architect – Governance	P1
2	Enterprise architecture	Enterprise governance	10	Executive governance	P2
3	Application development	Tool Support	5	Multi-skilled specialist	P3
4	Enterprise architecture	Enterprise Governance & Business Architecture	10	Executive: Business Architecture and Best Practice and Tools	P4
Interview No.	Department	Team/Group	Department size	Roles	Participant
5	Business Support	Business Analyst	50	Business Analyst	P5
6	Application development	Omni-channel	100	Executive omni-channel	P6
7	Application development	Asset-management: core banking	30	Multi-skilled specialist	P7
8	Application	Omni-channel	50	Resource	P8



	development			manager	
9	Application development	Asset-management: core banking	10	Executive Core Banking	P9
10	Project Management Design Analysis	Process Engineer	50	Executive: Process Improvement	P10
11	Application development	Finance	10	Manager Finance	P11
12	Application development	Omni-channel	10	Multi Skill Specialist omni-channel	P12
13	Business Support	Business Analyst	50	Business Analyst	P13
14	Business Support	Business Analyst	10	Business Analyst	P14
Interview No.	Department	Team/Group	Department size	Roles	Participant
15	Enterprise architecture	Enterprise Governance	10	Lead architect – Governance	P15
16	Enterprise architecture	Enterprise architecture – Business Architecture	20	Lead architect – Business Archi-	P16



				test	
17	Application development	Core banking	100	System Analyst	P17
18	Programme and project management	Omnichannel	50	System analyst	P18
19	Application development	System development enablement	10	System analyst	P19
20	Enterprise architecture	EA: Core banking	15	Lead architect – Core banking	P20
21	Enterprise architecture	Enterprise architecture – integration architecture	15	SOA architect	P21
22	Enterprise architecture	Enterprise architecture – infrastructure architecture	10	Infrastructure architect	P22
23	Enterprise architecture	Enterprise architecture – data architecture	15	Data modeller	P23
Interview No.	Department	Team/Group	Department size	Roles	Participant
24	Application development	Application development - Integration	20	Integration System Analyst	P24
25	Application development	Application development – Core Banking	20	Senior Manager	P25



26	Business Support	Project management	30	Business Project manager	P26
27	Application development	Application development – infrastructure architecture	20	System Analyst	P27
28	Enterprise architecture	Project management	50	Project manager	P28
29	Application development	Application development	8	Enterprise multiskilled specialist	P29
30	Application development	Application development - Integration	20	Integration System Analyst	P30

3.7.5 Data collection – interviews

Interviews are done to gather descriptive information about the real-life experiences (Knox, & Burked, 2009). The advantage of having face-to-face and telephonic interviews is to have social interaction information like voice tone and emotion that is relayed with the message. An advantage of face-to-face interviews is body language. Because of the distances between geographical groups at different sites in different cities across the country, most the interviews were telephonic. This makes it possible to reach and access people in hard-to-contact areas (Opdenakker, 2006). In this research the social cues are less important and the information extracted from the interviewee will be used. The interviewer also had a limited budget and could not travel extensively to most the people that needed to be interviewed.

As stated earlier, data collection and data analysis are co-created by the researcher and the participant; the theory is constructed rather than discovered. As previously mentioned, the researcher interviewed an expert in the field of enterprise engineering who first created the



innovation life cycle. This was done to get the richest information from the start regarding the reason why the innovation life cycle was implemented, what the shortcomings were of the previous methodology and what strategies the organisation employed to overcome the challenges. It was also done to receive pointers on where and whom to interview.

The initial open-ended questionnaire was based on the research questions (See Appendix A) and the innovation life-cycle phases (see figure 2.1 and Appendix F). In the first interview the innovator of the innovation life cycle has given me a conceptual map of the phased/cycles of the innovation life cycle with meanings attached to each phase in the context of the enterprise engineering framework (see Figure 2.1, Appendix D, E and F). During the interviews, more questions were asked particularly about challenges the research participants experienced during any of the life cycle phases (see Figure 2.1 & Appendix F). Questions were also asked about the strategies the research participants employed to overcome challenges, what happened, why it happened and how they repositioned themselves to be more effective and competent in what they do as individuals and as a team.

A small upfront sampling plan was devised with the input from the first four interviews. This was done so that interviews could be scheduled ahead of time and conducted in a pre-ordained manner. To introduce as much flexibility as possible into the preliminary sampling plan, departments were chosen in relation to a conceptual mapping of user roles as depicted in the in-house definition of the method usage, roles and responsibilities.

For example, in the initial sample plan, 4 formal interviews were held with at least one subject from each business unit. This allowed the sample size from each business unit to be defined. The spectrum of the sample was to get a 360-degree view of the usage and understanding of the innovation life cycle. There were numerous similarities among these respondents and saturation was reached very early (examples are: the challenges of misalignment between requirements and design, the duplication of enterprise capabilities and the importance and lack of the correct competences and skills) but only for some details (examples are: domain specific challenges in SOA domain, data modelling domain, detail design domain, software development domain) the researcher conducting a few additional interviews, deeper knowledge of each respective area was uncovered. More details in the data analysis section. All respondents used the development lifecycle in



conjunction with EA for some form of governance during a project lifecycle. The selected respondents were the most experienced in those roles for each respective area. Each of them had more than 20 years' experience in IT and used methodologies like Waterfall, Prototyping, Dynamic Team, Rational Unified Process (RUP), Agile (Scrum) and CMMI.

Due to the strict work schedules and lack of available time of senior IT personnel, the extent to which ease-of-access sampling could be followed was limited. Interviews thus had to be scheduled well in advance. The participants that are the most experienced in using the Enterprise Engineering Methodology were chosen so that a full spectrum of and a clear 360° view of all users of the methodology were covered. This ensured that biased views could be eliminated.

3.7.6 Data collection – documents

3.7.6.1 Innovation life cycle documents

As shown in chapter 2, the innovation life cycle has various phases and during each phase different role players are involved. This also means that some role players are involved from the beginning only, whereas others join the team midway. The process is mainly divided into two major processes pre-execution and execution. A project manager drives the whole process end to end across both sub processes. During pre-execution, the enterprise architecture department drives the demand of business requirements to ensure the architectural solution fits the exact requirement. After pre-execution, has been finished, the application design and development team will go into detailed design and development of the software solution. During the second sub process, which is more of a standard software development life cycle process, named the execution, the development manager, team process manager, solution designer and software developer are involved.

3.7.6.2 Process improvement and Agile case research report presentations

In the last interview of the first set of twelve interviews, the researcher was directed towards someone in the organization, an in-house researcher in the process improvement department, who without my knowledge had been doing research about the innovation life cycle for three years. The researcher has concluded two in detail formal interview sessions with the participant. Thereafter, during validation, the analysis done by the in-house



researcher were compared to the challenges and strategies found in this research study. Documents were used as a secondary source of data research study to validate this research study.

3.8 Data analysis

The first phase of the coding is called initial coding by Charmaz (2006). The purpose of this coding is to open the codes so that the data can be released. The data is broken down in finer details. The full data analysis process is shown in the diagram below. The first set of four interviews was done using initial coding and thereafter focus coding. Thereafter theoretical sampling took place which led to multiple points of interactions based upon the gaps in the data or confirmation via validity of the data. More details for each step are described below.

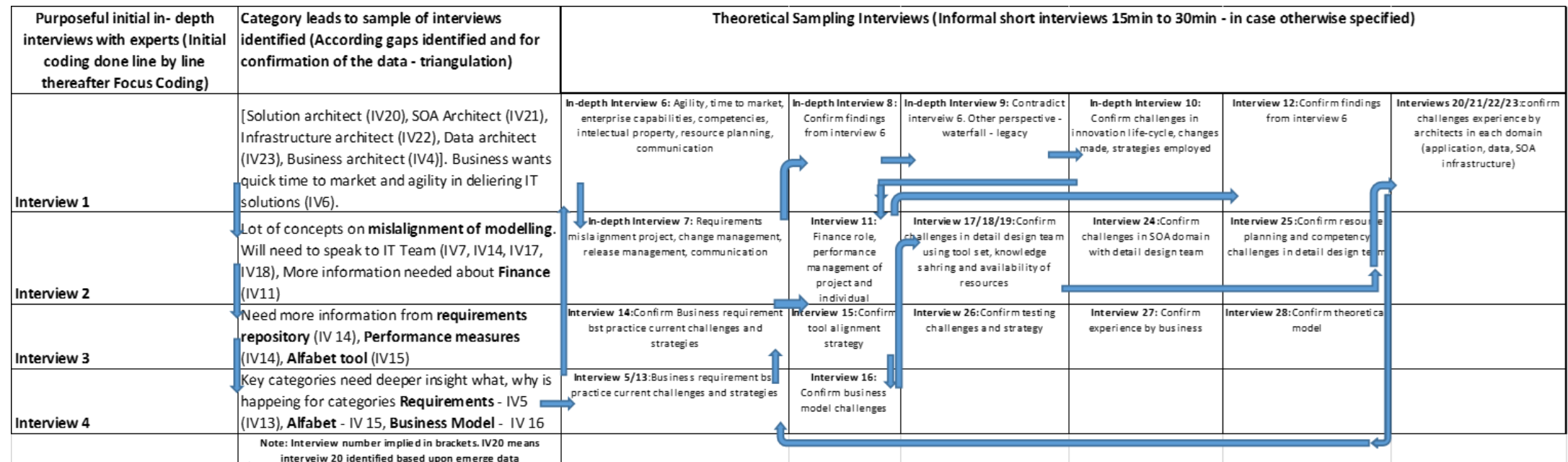


Figure 3-4 - Full process of data collection during theoretical sampling

The interview number show the sequence of when the interview was held and the arrow the direction which interview was conducted before and after. In each interview block a brief text description do tell the story line of how the data collection, data analysis and validation has taken place.

3.8.1 Initial coding – Creating open codes

After the first interview the initial coding started together with the field notes made during the interview. The researcher has used a mix of coding techniques. First, the document was scanned as proposed by Charmaz (2006; 2014) and key points coding were used (Glaser, 2017) to code sentences and paragraphs. Thereafter, line by line coding (Charmaz, 2006 & 2014), which was first coded by using descriptive coding (Hogan, & Coote, 2014) interpreted as coding a sentence by sentence or phrase by phrase. Major key words were also highlighted doing some microanalysis. A detail description will follow in the next sub-section.

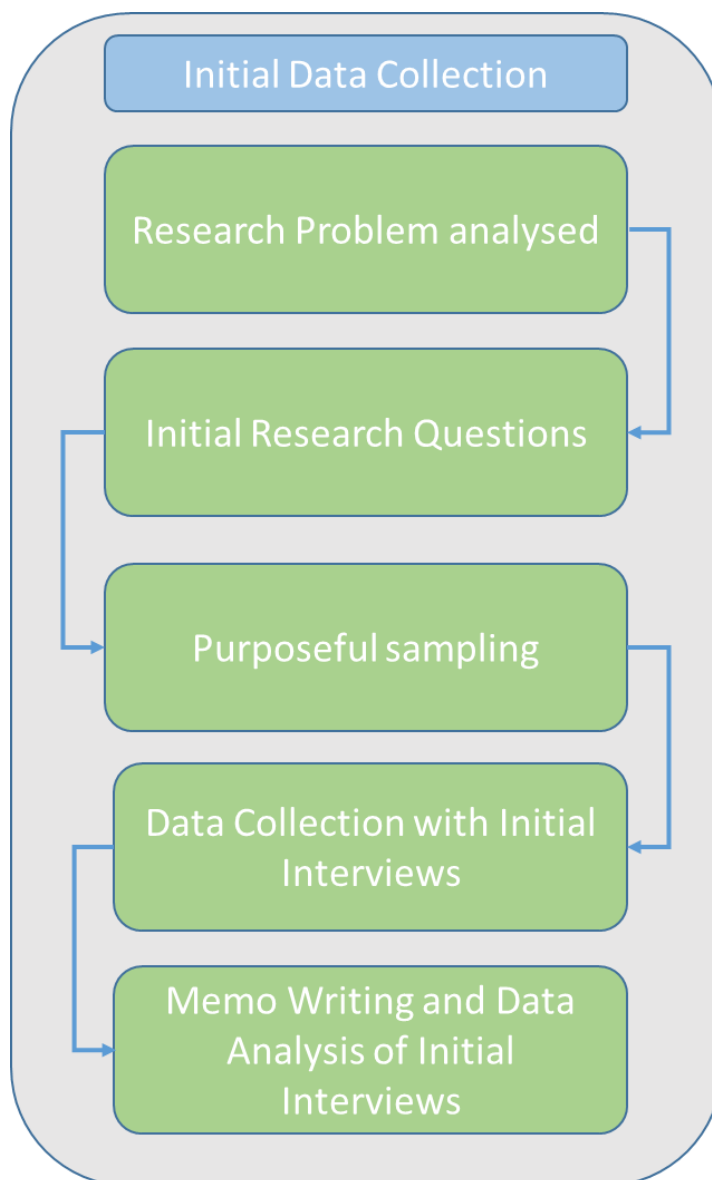


Figure 3-5 - Data collection and initial coding

There were four initial interviews which has covered a lot of depth in all domains. After each interview the interview was transcribed and coded. After each interview codes were compared and

analysed to form new codes and proposed categories. Thereafter theoretical sampling was applied for some finer details in specific roles and areas not fully known (see Table 3.1).

3.8.2 Focused coding – Creating categories and concepts

After initial coding, an additional eight research participants were identified by research participants themselves whom to interview next to gain information for a specific field of expertise from subject matter experts. Follow-up interviews with the subject matter experts were interviewed to express their views and experiences in the context from their own “world” of reality.

Additional data collection and data analysis followed the initial process where initial coding for each interview was completed (see Figure 4.3). Then after each interview a MEMO was written to give some thought about the current research context, who to interview next, would it be appropriate, and any gaps or findings uncovered so far.

Focused coding takes place interactively; key points coding was used (Glaser, 2017) to code sentences and paragraphs. Thereafter, line by line coding (Charmaz, 2006 & 2014), which was first coded by using descriptive coding (Hogan, & Coote, 2014). The codes that appear the best are chosen first and then merge with others to form categories. The categories are, therefore, generated from the data. The initial and focused coding almost reached a saturation point after twelve interviews. No significant new concepts were uncovered by research participants with the same role as ones who were interviewed before. Where additional supportive interviews were held with some participants with other IT roles, only a few more detailed codes and categories were found, which strengthened the theory from that specific angle. Categories that emerged were validated by cross-checking have ten additional informal interviews but did not yield new findings. Due to the vastness of the different domains and different teams another very short focussed eight informal coffee sessions and observations were held with other participants not interviewed before to validate the research findings. This was to ensure that if the same findings would occur if asking the same questions towards someone else but working in the same department as the original participant chosen.

Focused coding will uncover those codes that relate to a common theme, pattern, anti-pattern according the actions, re-actions, experiences of subjects within the context of the phenomenon. As new codes are uncovered it confirming similar codes and strengthen them to form categories of similar codes. A constant comparison of codes is done to examine the data, forming categories

and concepts. Therefore, focused coding takes place interactively; the codes that appear the strongest are chosen first and then merge with others to form categories.

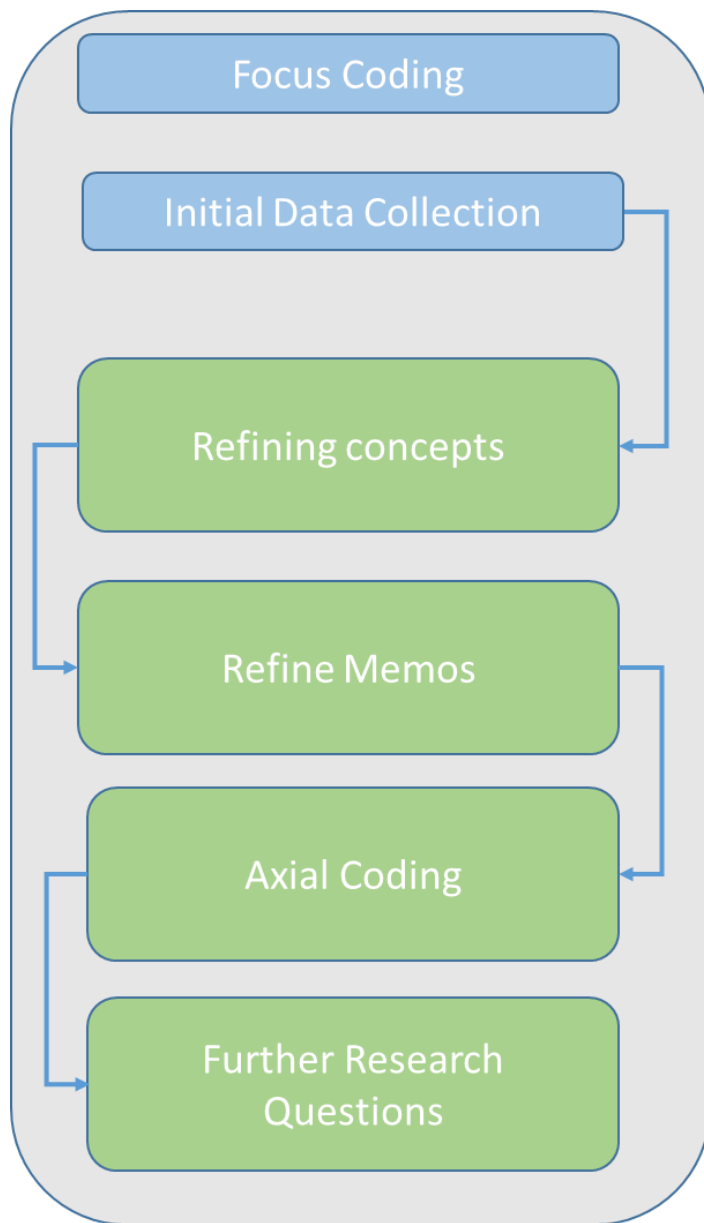


Figure 3-6 - Focused coding

The categories are, therefore, generated from the data. The initial and focused coding almost reached a saturation point after seven interviews. No significant new concepts were uncovered by research participants with the same role as ones who were interviewed before. Where additional

supportive interviews were held with some participants with other IT roles, only a few more detailed codes and categories were found, which strengthened the theory from that specific angle.

Although the researcher has not used axial coding per Strauss and Corbin's formal procedures, I have developed subcategories of a category and showed the links between them as I learned about the experiences the categories represent. The subsequent categories, subcategories, and links reflect how I made sense of the data. The Researcher did apply an open flexible method of axial coding as described by Charmaz (2006). Axial coding provided a means to find or determine relationships between categories by first relating subcategories to categories to look for dimensions or properties and then use these properties to link categories. It was also a means to find the most significant pattern of data-forming categories. It was a means to sort the data into groups that were related. A way to organise the data could be to focus on specific conditions or circumstances, actions or interactions and consequences. The naming of the categories also changed as the conceptual level got elevated. The conceptual names of categories had to 'grow', in other words constantly aligning with the data. The researcher therefore had to be theoretically sensitive to the forming of categories.

The researcher basically asked what the processes underlying this phenomenon were or experienced as well as what the consequences or factors of this process were. What were the thoughts, perspectives on, feelings and behaviour of the participants in the context of the phenomenon?

Memo-writing happen after each interview and during the coding and after the coding process. This assist with the reflection of what the data represents, to understand if overlapping codes merged into higher level codes called categories and similarly also the merging of categories into concepts. and reflexivity Memo-writing assist with having an account what the thoughts, ideas was of the researcher after each interview but also documenting any awareness of actions, events or emotions by the research participants. This also assist the researcher analyse where the gaps are in the data, which domain of interest still need saturation and which categories can form into theoretical concepts.

The iterative process of using a combination of focus, axial coding and memo-writing helped to form the theoretical concepts from the data. While identifying the data elements that do need refinement the researcher use a strategy called theoretical sampling to actively collaboratively with the research participants get insight whom to interview next until saturation point has been achieved.

3.8.3 Theoretical sampling

Grounded theory is an induction process whereas the data is collected, interviews are transcribed immediately, the data is analysed, coded and categorised until saturation point has been reached. During the data analysis, the codes that need further investigation gives guidance on the next “step” of the process which could be one of many options, depending upon what the constant comparison process revealed or indicated direction. During analysis, a new data with new categories had been added with new codes if saturation point had not been reached yet. Additional data collection could take place or if a saturation point had been reached, then the grounded theory process was finalised where after the findings and discussion of the research study were written.

3.8.4 Rigor in grounded theory

Grounded theory in context of software development have been discussed by Adolph, Hall & Kruchten (2011). The main concepts pointed out was that a grounded theory research study should show that the findings are representativeness subjects and conditions, can the findings be reproducible and was it consistently executed and presented, was the findings consistent executed towards to the research participants and can the findings be generalized towards other theories or contexts.

3.8.5 Validation - Triangulation

Triangulation is used to address the credibility and the validity of the data. There are various methods to apply triangulation. Triangulation methods use in this research study used multiple forms of data collection, such as focus groups, observation, in-depth interviews, informal conversational interviews and formal review with research participants to confirm the findings and results. A full flow of the conversations can be seen in table 3.1 above. Here it clearly shows the interactivity between different interviews confirming the information.



4 Findings

The main purpose of the findings chapter is to give a detailed account of the findings emerging from this research study. Section 4.1 is an overview of the data collection and data analysis conducted. In section 4.2 the challenges and strategies related to the innovation process will be discussed first, thereafter follow the challenges and strategies for each phase of an innovation life cycle. From section 4.3 to section 4.8 each category identified in context of the innovation life cycle will be described, starting with invention phase till disposal phase. Each challenge category and the corresponding emergent strategy category will be discussed together. The categories are as follows (a) the innovation process challenges and an agile product delivery innovation strategy (b) the invention challenges and idea management strategy (c) business model and the client value proposition strategy, (d) commercialization challenges (which include implementation and operations challenges) and the product portfolio management strategy, (e) culture challenges and innovation culture strategy, (6) knowledge management challenges and strategy, and (7) innovation management related challenges and strategy. An innovation management strategy will manage all these challenges.

4.1 Introduction

The purpose of the study was to identify the challenges when implementing an enterprise engineering innovation life cycle and the strategies to overcome it. Issues users experience when applying an innovation life cycle prompted the purpose of the study was to identify the



challenges when implementing an enterprise engineering innovation life cycle and the strategies to overcome it. Data collection and data analysis are described next.

Users of the innovation life-cycle were interviewed as prompted by investigation and enquiry. A detailed description was provided in the previous chapter. Data collection happened in an interactive manner. After each interview, the interview was transcribed in Microsoft Excel. Each interview text was transcribed separately on its own excel sheet. The

interview text was labelled via open coding. Next to each line of transcribed text a line number was added and the list of open codes. Next to the list of open codes, subcategory and main category columns were added. The coded-version of the interview text was copied to a main workbook which contained all the interview texts that were already labelled and coded. All the open codes were channelled into subcategory codes. Thereafter all the subcategories were compared with each other in context of the line of interview text from which it

emerged. Concepts were aggregated in higher level concepts to form the main categories. The coded interview texts with the codes were compared across the whole list of the “labelled-interview” version with additional columns showing the subcategories and categories. The properties of the subcategories were analysed to form links between categories. A memo was compiled by summarizing the main subcategories and main categories that emerged from the data. This process of interviewing, transcribing and coding was repeated as shown in table

3.1 in the previous chapter. A brief overview of the data collection and data analysis will be described next starting with an overview diagram figure 4.1 showing the outcome of the research study.

Data collection and analysis were carried out using the constructivist grounded theory methodology. No specific one core category was chosen as per classic grounded theory but as described by Charmaz (2006). The data describing the phenomenon was documented as it was communicated and no force category emerged. No specific one category emerged as more important than any other as the usage of the innovation life cycle spanned across the enterprise and involved many stakeholders. Each one’s opinion and responsibility was taken as equally important. Challenges encountered during the business analysis phase and the strategy to overcome those challenges is very important for a business analyst. Likewise challenges



that arose from systems modelling or project management and the strategies to overcome those are just as important from each user's role and responsibility perspective because each role-player in the innovation life cycle is important.

4.2 Innovation management strategies

The outcome of the research is shown in an overview diagram as figure 4.1 below showing the enterprise strategies that must be applied to implement an innovation life-cycle. Innovation management strategy is the top enterprise strategy focus on the management of innovation in an organization. There are four core strategies and four support strategies. The four core strategies are agile product delivery innovation strategy, idea management strategy, client value proposition strategy and product portfolio management strategy. These address challenges regarding the innovation life-cycle. The other supportive strategies support innovation to make it more efficient and effective however the challenges related to each of the supportive strategies have a great influence on how the innovation life-cycle is executed.

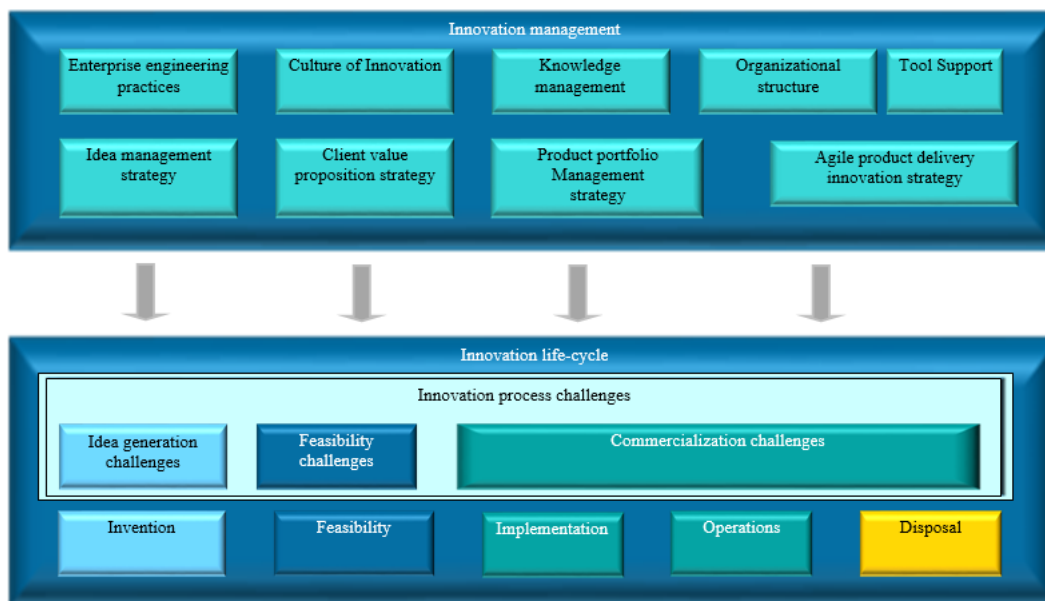


Figure 4.1 Enterprise Strategies to overcome innovation life-cycle challenges in context of a generic Innovation Life-cycle

Over one group managed the standard innovation life-cycle. It was put in place by a management team in enterprise architecture (EA) but later the team move to the project manage-



ment and delivery group so that the innovation life-cycle governance and execution planning can work closely together.

P01T71	“The innovation life-cycle should be managed , there are the process improvement group, monitoring the innovation life-cycle, and there is an agile centre of excellence to manage the agile innovation initiatives . There is the project management delivery group that manage the governance . We are busy merging and creating hybrid waterfall method as well. ”
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The new agile methodology was built by an agile centre of excellence under the process improvement team group. This group also have moved to the project management and delivery business cluster. Both organizational moves are to have closer alignment between the three teams.

P2T56	“Establish a central group with experienced and dedicated Agile experts and coaches that is headed by an Organisational Transformational Agile coach”
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The agile centre of excellence provides subject matter expertise (SME), agile coaches, to aid the organisation in understanding, using, and internalising Lean and Agile values and practices.

4.3 Innovation process challenges and Agile product delivery innovation strategy

In the following sub-sections the challenges related to the innovation process execution, that is what participants experienced while using the life cycle as a mechanism. Participants who working on big projects using the traditional waterfall approach were interviewed and participants using agile principles and have established the agile principles in the projects they delivering. An overview of the challenges and strategies are shown in table 4.1 below.



Table 4-1 Innovation process challenges and agile product delivery innovation strategy

Innovation process challenges		Agile product delivery innovation strategy	
Challenges	No of occurrences	Strategy/ Best practice	No of occurrences
Slow time to market	33	Agile product innovation process	22
Delayed return on investment	5	Dynamic systems development method (DSDM) framework	20
Lack of business involvement	3		
Lack top management commitment	3		
Constrained product focus delivery	4	Lean client centric based delivery	32
Inconsistent process execution	4	Governance and Process improvement best practices	15
IT Management and Governance cost too high	7	DevOps innovation cycle principles	5
Total occurrences	66	Total occurrences	84

4.3.1 Innovation process challenges

In the table above, table 4-1, the challenges are listed with corresponding strategies that were employed to address each challenge. An overwhelming account of 66 incidents show on that the process is too slow and project delivery cost is too high. A high response of 84 incidents, indicating the mind-set of participants geared towards a response of wanting to work more in an agile fashion or already applied agile principles in a hybrid agile-waterfall fashion or working using an agile methodology.



Since the first year of applying the innovation life-cycle, the organization have assigned a process improvement team monitoring the usage of the innovation life cycle and investigate how the process can be optimized. Detail of each challenge and strategy will be described in the next subsection below.

4.3.1.1 Slow time to market

In large organizations, big project initiatives are in the order of the day. One of the major drivers for implementing an innovation life-cycle is to reduce cost and time to market. With an anew implemented innovation life-cycle business expects efficiency of service delivering IT solutions enabling the sales and maintenance of their products and services. The quicker IT solutions can enable business solutions the more competitive position the organization have compared to competitors.

P2T56	“There is a need from business that GT have to deliver a project quick as possible because IT is too slow and cost too much.”
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The organization does track the overall efficiency of every project for the full duration of the innovation life-cycle. For each phase the activities and tasks are tracked between the start and end dates. The duration of each phase is recorded together with the complexity rating in function point count. The overall efficiency is calculated with delivered cost in function point count divided by estimated function point count. The productivity is measured by the actual function point count divided by the hours worked. Therefore, the number of hours spent do have a direct impact on the overall efficiency of the innovation life-cycle. Business wants more results with fewer resources used. The complexity of the innovation life-cycle process impact the duration and time to complete activities and tasks. There were too many artefacts and tasks in the default implementation of the innovation life-cycle. Both factors, the complexity to understand the activities’ dependency upon one another and to adhere to new templates and standards to complete tasks, have both increases the expected time to deliver projects.

P4103	“Do we have to do all the governance gates? Why we all this red tape? It takes a long time; can we do this faster?”
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The time and breaks between one phase handover to another during governance was too long. Resources cannot be utilized or allocated to other projects during those times when governance or management decisions takes too long to be finalized.

P01T61	“We have decrease the time it takes for the feasibility study to complete. We should do less documentation. The modelling takes a long time. We need a different way of doing things. “
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The amount of standard documentation and templates to fill in has taken too much time during the concept development period for new products. The resources working in the implementation and operations phases were under pressure to deliver under tight deadlines and completion dates to ensure efficiency. This also have a push-back effect from the detail design and development teams back to business and enterprise architecture to have more of due diligence during feasibility phase. This was to ensure that the function point count estimation done for the implementation phase can be as accurate as possible. Implementation teams have developed internal checklists which must be adhered to before handover to the detail design and development could start. This, by itself, have added additional task time at governance gates to ensure a checklist is completed instead of focussing on the bigger goal delivering business benefit as quick as possible. Most detail designers and developers coming from working in a traditional waterfall background are adamant aiming first for perfection of requirements and high level design before commencing any work.

Business and IT coming from a background to minimize the risks of a project, they want the impact requirements have and cost estimation to be as accurate as possible. Those also do not want to take any risk working with uncertainty of requirements that are not clear or changing. This is to minimize the amount of technical debt and rework which will be additional cost after a project is completed. Due to the large set of requirements for big projects, the amount of pre-analysis work that need to happen to determine the right level of detail for detail requirements before any detail design can start is time consuming. The time spent analysing the detail requirements for doing the detail designs take longer as these must be modelled and intrinsic system details must be investigated. This lead to long phases in innovation life cy-



cles where the philosophy is to first get all the requirements upfront in the right level of detail according the BRR governance gate rules.

P10T59	Big Design and full detailed requirements up front in the lifecycle enforces a lot of governance and management time from resources to complete each phase. Making the phases too long before business can see any artefact that is produced.
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As one participant, also confirmed during the interview that people in large organizations are used to execute projects with extensive requirement analysis upfront and extensive high level design and detail designs.

P6T24	The challenges in commercialization are that people are too focussed on big bang approaches. People in the Bank is risk adverse and managing their risks. They want to wait for a big bang approaches and validate it about 200 times before it gets released and when you can start making money from it. I think the approach of commercialization should be relooked at.
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This is in contrast with teams using an agile methodology that have learned to cope with changing requirements by prioritizing them according business needs. More about this strategy in the “Agile product innovation process strategy” sub-section 4.2.2 below.

4.3.1.2 Delayed return on investment

The slow time to market impacted the return on investment for big projects. Observing one of the long-duration projects completed by the organisation. The observations were due to complexity of business needs and the frequent changing of requirements the project was delivered later than initially expected. One participant has explained to the researcher why business wants a quick return on their investment.

P43T01	If projects take too long to deliver, then the return on investment of shareholder money is low. This is because by the time the project is delivered over many years the technology stack is old and not flexible to change or adapt to business needs.
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To compete against competitors that have the same digital strategy solutions need to be delivered fast and first in the market. Due to the customers' needs transforming, the business need IT solutions to be delivered in much shorter time frames as before. Money spent on IT solutions must be recovered in shorter time frames to reinvest again in innovative solutions. The value of IT assets depreciates over time like any other asset. The value that the IT assets return become less therefore the income become fewer.

4.3.1.3 Lack of business involvement

During observation one of the research participants make a remark about the work that must be completed by a business analyst and are now expected from IT to complete the business requirements together with the detail design. Expectation from even IT stakeholders working primarily in "detail design" phase was that business should be more involve and participate. The researcher has observed that in over one project, notably in those projects that are huge, business representative is low. They tend to only interested in how much money projects will cost and how long it will take.

P17T05	We do not have any user screens requirements from the business analyst. Business expects the business analyst to draw up the screens but now it is pushed back to IT to designs the screens. How do we know if business will accept the screens we propose? They are not involving at all.
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The observation here was that end-users of the IT system have been involved in limited fashion. In huge projects, a business analyst does not know all the issues and problems of why certain requirements are needed. The gap in knowledge between the end-user of an IT system and a business analyst can be large, depends upon the exposure the business analyst had on the daily operations of the business using the IT system. The lack of business involvement at all levels of the organisations lead to incomplete requirements and make it difficult to determine the prioritization of requirements.



4.3.1.4 Lack top management commitment

Top management want to see the value of what IT projects will deliver before they come on-board and give full support for an initiative. Experiences also play a role here.

P20T07	Top management of business rarely do get involve they are only interested in how long the project will take and how much money the projects will cost. There are decision-making times where we do involve them but that are only at a very high level.
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Continuously, after many years of funding big projects executed in long phase cycles, top management in large organizations have been resistant to show full support for initiatives where they do not see business value materialized quick enough.

P43T02	Based on experience rather than on gut feel; until people see the value of what is being done there can be resistance to come on-board.
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There are also a different in opinion between senior business managers and senior IT managers which projects have the greater priority for resource allocation and stakeholder involvement. What a priority was for business was not a high priority for IT. There was a communication gap between business and IT how projects were positioned in roadmaps. This has led that the way roadmaps were positioned has changed so that the context for business strategic initiatives can be seen in context of the greater transformation IT roadmap plan to build enterprise capabilities. Business clusters were accustomed to only build isolate IT solutions for themselves and no building enterprise capabilities. Now IT have a strategy to build enterprise capabilities business clusters share the costs cross the organisation, different business was clusters was reluctant to support big initiatives where they could derive what value it will have for them. This has led to an initial response from business to hesitate to be involved unless they have a full understating what IT applications will provide value in the long term. Presentation of enterprise architecture solutions was adapted to reflect target tactical versus transitional versus tactical.



4.3.1.5 Constrained product based delivery

Due to the focus of business clusters on delivering point solutions, the organization has built capabilities which cannot be re-used across the enterprise. Point solutions are solutions that are constraint by their functionality and re-usability from an enterprise perspective. These are IT systems that are vertically focussed in context fulfilling only one business cluster's requirement for an IT domain. This also has led to many of the same type of IT system developed. For example: for each business cluster, there were many document management systems. Each one very similar in functionality but bought from different vendors. This made migration or merging of the application code into one enterprise applications nearly impossible without spending much more than buying an off-the-shelf application and customize it anew. These types of IT applications are product-based in context of the business cluster's only need and not in context of the organisation's client-centric strategy. These are solutions that do not deliver enterprise capabilities but IT applications that are not re-usable across the organisations.

The requirements for those IT-products were developed in context of one business unit's perspective at a time, making the process to enhance those IT capabilities difficult. To migrate or merge business cluster specific capabilities to enterprise capabilities, making them re-usable across the organization, were too costly. To achieve such a transformation plan, a new project must be launched for each new enterprise capability that needs to support similar functions across all business clusters. Therefore, eliminating duplication of IT systems, reducing total IT project costs and IT support and maintenance costs.

4.3.1.6 Inconsistent process execution across organisation

A major stumbling block during inception of an innovation life-cycle was the immaturity of the innovation life cycle itself. The previous methodology used in the organization was based upon CMMI and was limited with best practices and standards support to users. The version of the CMMI method caters only for development areas and delivery cycles, have too few best practices, to slow to align with business clusters and have no agile practices. To work in



an agile manner, users of an innovation life cycle must understand the purpose of the method, what can be tailored and how to do it. It is also a mind-set change. The findings suggest that the participants do not understand the purpose of the processes in the innovation life-cycle.

P4T03	The process is there but consistency of the execution is still not there . Therefore, if you look up the various artefacts across various projects, it is not a consistent way of doing that. I think there are still significant work to be done by the way we are doing artefacts , where we store it and how we manage that over the life cycle .
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Interview respondents have point to that they want to understand and apply the method correctly but new concepts take a while to be grasped. Not all activities and tasks were always executed Inconsistency of execution occurs if users do not follow the guidance according the practice manual because they do not know how the governance gates work. The innovation life cycle governance best practice manual request that these deviations need to be managed via governance before each phase, during each phase and at the end of each phase. To be consistent users must make sure artefacts have the correct content before the consumers in the next phase of the innovation life cycle and apply the governance guidance correctly. Also, the storage and the update of documentation must be consistent across the team.

4.3.1.7 IT Management and Governance cost too high

The innovation life-cycle has introduced a lot of best practices and standards that were not there before. So, the more it tries to cover high quality artefacts since the start by enforcing everyone to do all the activities and task due diligently. The innovation life-cycle incorporated many best practices to cover all possible angles in the quality of artefacts when enforcing standards across the enterprise, moving away from single IT department delivery cycle to enterprise innovation cycle. Each department have their own standards or no standards at all. A financial system is not a defence system which require high zero-tolerance errors when drafting requirements, design, development and testing. In the beginning because the innovation life-cycle was new and Top management want to achieve results from using the innovation life-cycle as quick as possible, IT Executive committee has requested that everyone has



the follow the innovation life-cycle “to the letter”, all governance gates must be followed and passed.

P10T60	Comprehensive Systems Development governance structure providing proactive assurance and risk mitigation but the execution thereof is time intensive and the management cost too high .
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To adhere to the Exec request, senior management in IT over management of the innovation life-cycle process, so that the management cost was most cases almost half of the total project cost.

4.3.2 Agile product delivery innovation strategy

One research participant explained that the innovation life cycle process needs to be changed first, see P01T02 below. Another research participant has shared how the participant have proposed a new way of working, innovative life-cycle, see P40T03, P40T04, P40T05 below. This is so that the organization can explore some quicker method or modus of operation to deliver products quicker to the market. As the understanding of the activities and tasks have become clear, business sponsors have complained about the delivery cost that is too high and have searched for alternative solutions that are not yet allowed in context of the governance framework put forward by enterprise architecture and the process improvement team. This is necessary so that management can assist and support to create an innovation culture where employees have opportunity to share and express inventions.

4.3.2.1 Agile product innovation process

For the organization to be successful the IT department must assist business to deliver IT solutions quick to the marketplace. The means to do this are combinations of strategies. Firstly, be client-centric focus in what need to be put in the marketplace; secondly, can recognize quick wins instead of having a one huge project approach with long period of feasibility phase. As mentioned by the research participants that innovation product and services can be delivered by adjust and configure instead of design and build IT applications every time.



This, by itself, will save time pushing ideas to the market. An innovation life-cycle that is incremental and not “big bang” approach, increase value to customers, respond to change quickly, transform smoothly as possible and have early results and short feedback loops to business.

P6T02	<p>” Aha, for the bank to view itself successful, oh. (great waiting, hesitation before answering. thinking). That is a difficult one because one can view this from a software technology or a business perspective. From a software technology perspective, I think...to view themselves as successful... they are able too. (thinking). Assist the business unit to quickly generate new products or create unique experience for the customer utilising software that they have, that they can use to adjust or change or configure and not always have to build. Then I believe one would be successful to the bank. ”</p>
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An agile product innovation strategy increase products and services with fewer resources, less time and reduced cost to market.

P10T06	<p>“We want to continuously adapt and stay flexible while increasing products and services with fewer resources, less time and reduced cost to market.”</p>
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Business also wants an innovation life cycle that reduces the time to commercialize products into the market place. As one participant mentioned that a competitor organization are far more innovative and sharing of ideas. This also portrays that to be complete one need a similar culture of innovation. Another participant response was that: “why bother sharing ideas because no one will ever have heard of it. Throw the letter in the box and no one will ever contact or give feedback if any idea was looked at”.

4.3.2.2 Dynamic systems development method (DSDM) framework

Stakeholders need to understand the benefits that lean and agile approaches can bring. Attaining senior management buy-in to the approach is the largest assisting factor for agile introduction. They need to understand the values, the agile framework and details of their new



working practices and what is expected of them. This will ensure their involvement and commitment.

P10T22	“We adopt DSDM principles for project management practices that will elevate the following benefits: achieve early delivery of business benefits, increase efficiency and effectiveness and address management commitment to be involved at all levels of the organisation. By early feedback loop communication to senior management we do show them the value and they do get involve from the start.”
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The dynamic team principles have contributed that stakeholders buy-in to a way of working to work together from the start right to delivering the end-product. This is a big-step forward in contrary to how business has been involve in the past.

P40T04	““The innovative process function in a cross-discipline way working together as one team with stakeholders in content design, sales, marketing, engineering and offering management to include in design thinking activities, key decisions, workshops, and milestone design,”
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The positive outcome of working closely together with IT in an agile manner also had a ripple effect on the stakeholders using the traditional waterfall methodology. The same attitude and approached have come from business towards IT projects working in the traditional manner. Business clusters have become more involved in different types of projects, small agile projects that are user experience front-end specific to big waterfall projects that involves a lot of integration and back-end work.

4.3.2.3 Lean client centric based delivery

The organization has moved away from only focus on product centric market and instead focuses on client-centric perspective. A product only focus has causing the organisation to only focus what products and services it brings to the market and not what the client’s needs and wants are.

P10T57	The organization is faced with fiercely competitive and challenging market forces that require us to continuously adapt and stay flexible to enhance client experiences and business value. This has led us to have a client-centric focus IT projects.
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4.3.2.4 Governance and Process improvement best practices

There were a lot of activities and task in the original published methodology which was taken out to simplify the process and make it more understandable.

P01T70	“There were a lot of activities and task in the beginning which do not add value to the whole Innovation Life-cycle which had made the process costly and time-consuming”.
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The more flexible the innovation life-cycle was the more users could tailor the innovation life-cycle so that only those governance gates necessary are executed. Governance gates were also merged in small projects so that the technical review board only need to sit once for the entire decision making.

4.3.2.5 DevOps innovation cycle principles

The organization have used best of breed best practices that include DevOps to allow for agility in low risk, low complexity projects but also transform the IT support teams’ development life-cycle to commercialize changes to IT systems swiftly.

P10T58	“DevOps principles will be used for low complexity projects and low risk projects. This make sure we cater for agility in our portfolio of projects. Not all projects are complex”.
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This strategy has eliminated the overhead of too much governance and management time on IT support projects and on low complexity projects with low risk.

4.4 Invention challenges and Idea management strategy

In this chapter the challenges that arise from invention generation phase are described and the strategy to overcome those challenges. The table 4-2 below summarize the challenges. There were not few participants who were possible to respond. Only a few have understood the purpose of idea generation in the innovation life-cycle. Most have assumed ideas must come from business only.



Table 4-2 Invention challenges and idea management strategy

Invention challenges		Idea management strategy	
Challenges	No of occurrences	Strategy/ Best practice	No of occurrences
No actual invention process	2	Idea innovation sub-process	3
Poor idea management	4	Idea management forum	2
No opportunity to share ideas	4	Idea sharing platform	2
No Research and development opportunity	2	Research and development teams	3

4.4.1 Idea management strategy

Some research participants feel intimidated or alienated from of the innovation process. There is a need for an innovation strategy that do allows for employees encouraged to share ideas.

P40T01	“There is no innovative idea management here like at my previous employer. There everyone contributes and share. “
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To compete at this, level a strategy must be put in place to gather ideas from all employees and not only business owners, business analysts, business architects or senior management. When prompting the participant if this aspect was addressed successfully, the answer was (see P01T02) that idea generation must be managed as part of innovation management.

P01T02	“No, this is work in progress. The idea generation aspect of the innovation life cycle has not been looked at properly. All the main functions of the innovation life cycle are in place. But for ideas to be transformed into innovative products a lot need to happen still. We need to be able to log ideas, make it easy for user to communicate ideas , log them, evaluate ideas and prioritize ideas. Currently each business unit drive its own initiatives and new no ideas are really explored across the organization.”
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Each innovation first start with an idea and evolve into innovation if successful. Here we see that potential ideas coming users of the innovation life cycle is not evident and they do not have little opportunity to make their ideas known or even have it investigated and tested. Contrary business wants a process so that ideas can be made visible from all employees and be brought to the market faster.

The organisation under scope of the case study also launched idea opportunities not held before, for example “hackathons” where idea competition was held to harvest ideas. This give opportunity for architects, system analyst and software developers to design ideas, prototype them and showcase solution to problems in a practical manner. At another level, an invitation was given to everyone in the IT business unit to put together innovative ideas into proposals for top management to review. The top presentations would be given opportunity to a leading management conference.

To continue seeking better technical solution to compete with the Fintech innovation market, the financial organization has also established groups of research and development (R&D) groups that do work together with an established innovation hub which do have the latest technology platforms installed for testing out new ideas into invention.

4.5 Business model challenges and Client value proposition strategy

In this chapter, the ‘client value proposition strategy; will be discussed together with the challenges they address. The use of the ‘enterprise business analysis strategy’ and the ‘enterprise business capability strategy’ (see table 4-3 below) to support the client-centric focus strategy of business overcoming business model innovation challenges.

Each business model challenge is described in context of the strategy that will address the problem.

Table 4-3 Business model challenges and client value proposition strategy



Business model challenges		Client value proposition strategies	
Challenges	No of occurrences	Strategy/ Best practice	No of occurrences
Poor requirements management	12	Enterprise business analysis strategy	11
Fragmented business capabilities	10	Enterprise business capability management strategy	4
Siloed client value chain perspective	7	Enterprise client value proposition strategy	7

4.5.1 Client value proposition strategy

The Innovation life-cycle must deliver products and services to clients across multiple business units. To improve and overcome client value chain challenges there were a few characteristics, these will be briefly discussed. Client value propositions can be put into context of business capability model to explain and show the demands from a business benefit and a client-centric value perspective. The demand also needs to be positioned in context of the other client value propositions proposed in the organization. Each client value proposition will be supported by enterprise capabilities. Herby this will enforce the creation of new enterprise capabilities and the enhancement of existing capabilities. Client value chain proposition are those clients' centric proposals to clients that will bring value to their experience of having the product. It addresses a specific client need for a specific segment. Instead of focussing on the product, business must focus on the client needs first. This will enable them to have a client experience product that matches the competitive market.

P16T15	"The client value proposition strategy is crucial for effective marketing planning and activities. It is an understanding how a client will value your product. It targets a specific user with a specific expected user experience"
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High level requirements are derived from a business architecture model which do include the client value propositions an organisations will offer, the target segment this client value proposition will target, which need and wants are addresses, what offerings are there towards the clients, how does the client value proposition compare to current products and service offerings, what value and benefits are their for the client and the organization, which client value



chain mechanisms and business services will deliver the products and/or services, the business capabilities that will support the enabling of the creating the proposed offerings and supporting to offering in the marketplace. A client value proposition is still first just a proposal, then it is first tested in the marketplace to be viable, then a detailed business case is built around it how will the revenue model works to compensate the offering, how the fencing model will work to design, built and deliver the client value proposition. Together with this there also must be decide through which channels the product or service will be offered and supported. The client value proposition concept is seen here as the. Enterprise client value chain are the strategy is the theoretical concept that grouped together the ‘enterprise business analysis strategy’ and the ‘enterprise business capability strategy’. Likewise, the business model challenges concept presents requirement management, business capability model and client value chain model challenges.

4.5.2 Enterprise business capability strategy

To break down in-house politics creating a siloed mentality and focusing having single views on enterprise capabilities. can re-use the enterprise capabilities driving cost down and improve delivery of products and services. The focus should to re-use the enterprise capabilities driving cost down and improve delivery of products and services.

P6T23	“... If we have a single view of what a client is , and we do not have the in-house politics between the mono-line business units about who owns the client, it would be lot easier in design thinking...”
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Business capabilities are those logical building blocks that do describe the business model operate, how business services are provided, the organizational structure, business processes, who is accountable executing the processes operationally on a business component and IT component view. This is usually completed by a business architect using various tools and mechanisms. In the organization under scope of the case study, the business architects a collection of best practices two of them are the “business model canvas” and “business capability modelling” as Business Architecture Institute. Enterprise capabilities enable business strategic success. The positioning and the description thereof are therefore critical for business to know and can view how the current and future business model landscape looks like.



P4T50	<p>So, one of the biggest ones is that we do not know what the business architecture target state is. We must get a wider view on what is the technology architecture target state and that is something we have started to address now: to say where we want the organization to be in 2020 from a business architecture perspective. The operational model is different; our readiness to move away from branch structures; that type of thing. I think there are a lot of views on that so that makes it very difficult to align technology to business because there are many views but not a standard but a conflicting view of how should the organization look like and that translates into taking the business strategy you will find on there is now a lot more focused on what are the targets we want to achieve, i.e. what is the target revenue and market share and that. There are very little concrete actions to say if we want to have a revenue uplift we need to do A, B and C. That to me is probably currently the biggest challenge; we need to align to business without an understanding what the business architecture target state is.</p>
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As described by the participant the biggest challenge from the participant's perspective is to align business with IT and vice versa without a full target state of the business architecture, which is the business model described in context of client value propositions, business capabilities and planned revenue targets for those business demands that require the first attention.

4.5.3 Enterprise business analysis strategy

There need to be a change of mind-set from a business perspective that the demand is looked at from organization perspective and not from one business unit on its own. A demand is a very high level requirement or idea from business to realize products or services in the market. The business analysis and business architects must be aligned with other across pro-



grammes and projects in the enterprise. Misalignment here has caused business requirements not depicted in context of the business model which did haven't given clear context towards business what the real business case is. Misalignment also has caused some projects focusing on requirements that are not a high priority in context of the greater focus to create enterprise capabilities supporting similar initiatives as one programme and project. Similar projects have been grouped together to form a portfolio and prioritization of sort-like and similar requirements across the enterprise could handled as domain specific focussed streamed projects delivering specific value for business.

P4T02	<p>“To change the mindset from that in a business perspective, one would say each demand is looked at in scope of the whole group instead of looking at it in context for one particular business unit. That I think is a major change and the whole current view on agile and not only within this organization but also in the other organizations that need to be better.”</p>
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4.6 Commercialization challenges and the product portfolio management strategy

Commercialisation challenges are those challenges that do occur during the implementation and operations phased of the innovation life-cycle. The word commercialisation was chosen based upon the research participants’ responses (see response P6T24 in sub-section 4.3.1.1) that this is what they are referring and described it as such. Each of the commercialisation challenges will be discussed in context with the strategy to address it.

Table 4-4 Commercialization challenges and product portfolio management strategy

Commercialization challenges	Product portfolio management strategy
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Challenges	No of occurrences	Strategy/ Best practice	No of occurrences
Silo-based Programme and Project management	12	Product portfolio management strategy	11
Constrained performance measurement	6	Programme Performance management and Quality Improvement strategy	24
Misalignment of the skills and competencies needed for projects	10	Resource Management	4

4.6.1 Product portfolio management strategy

The need was expressed that there need to be an enterprise portfolio planning for all the demands across the organization. More than one participant has explained that the business analyst in each business cluster still look at client value propositions in a silo manner and not from what a client value proposition entails to look at offerings from client-centric perspective. This also make it difficult to group demands from business described in business case documents together from an enterprise perspective. Often some business cases were revisited so that context can be given if other business units do have similar requirements. If other business units do have similar requirements, the requirements were scoped on an enterprise level and prioritized and then delivered according a product portfolio strategy.

P4T04	“...if you assess that demand across all our current project portfolio and transformation strategy , we then fit in what we have put as a capability impact to have a better way of addressing the inter-cross change of the organization... ”
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For this to happen over one programme must be aligned with other project releases continually until all projects are commercialized, the solutions must be part of a greater roadmap showing the programmes across the enterprise in relation to one another and not for one roadmap for one programme only. Also, for the technology used across all programmes must be planned and road-mapped.



P10T27	Enhanced Business value by encouraging business to select features with highest business benefit to be delivered next.
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Business are engaged early in the process to select functionality that must be built for capabilities that will yield the highest business benefit. Business and IT alignment happen early in the innovation life-cycle and continual do so via continual engagement as per agile product delivery innovation strategy.

4.6.2 Programme performance management and quality improvement strategy

A measurement framework was established after a few years of using the Innovation Life-cycle to address the gap to determine consistent correct KPI that makes sense for business.

P10T15	Defined a measurement framework, providing a means to measure velocity, progress, bottlenecks, etc. 11 various measurement templates have been finalized and will automated in Rational Team Concert (RTC).
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As part of the framework was to have a perspective of delivering projects only to maximize return in investment and not just any IT project that are proposed. Priority is given to those projects that will give maximum benefits to the business.

P10T24	Maximize Return on Investment by taking an economic view when prioritizing IT spends.
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New Programme level balance scorecard was introduced to have an overview how a programme that do contain more than one sub-projects is performing and if the programme is on target according the collective whole of the smaller projects.

KGT01	“The purpose of this Programme / Project Score card is to set common agreed target for all teams and resources on the Pro-
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	ject...”
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This is also used to make sure that all team members across the greater project team (across the programme) do have common objectives and goals to work towards).

4.6.3 Resource availability challenges and resource management strategy

Most respondents have replied that resource availability is a problem, not that there are not enough human resources but the right resources at the right time to be available when a project needs them. Within the context of this research study, requirements could take longer to gather because of lack resource availability from the business and technical subject matter experts. For example, key resources with relevant business knowledge could be allocated to higher priority projects, resulting in the use of secondary sources of information to gather business requirements.

P6T15	Yes, and resource availability but it all goes to workforce planning. If you do it with the right skills, aligned to what you want to achieve and know upfront what you require, you will not transition... to the end state of meeting your goal but in workforce planning what is critical is building the right intellectual property (IP) and the right time.
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4.7 Innovation management and supportive strategies

The innovation management coherently support an innovation life-cycle through all the phases; from idea management, right through to commercialization. Culture of people was the biggest challenge implementing and optimizing the innovation life-cycle according research



participants interview responses and observation. Culture, knowledge management and enterprise engineering challenges will be discussed next.

Table 4-5 Innovation management strategies and related challenges

Innovation management challenges		Innovation management strategies	
Challenges	No of occurrences	Strategy/ Best practice	No of occurrences
Culture challenges	12	Innovation culture strategy	11
Knowledge management challenges	10	Knowledge management strategy	4
Enterprise engineering challenges	7	Innovation management strategy	7

4.7.1 Culture challenges and innovation culture strategy

During the interviews participants respond by explaining how culture have such a big effect on the execution but also in the manner stakeholders engage during the life-cycle.

P40T05	<p>“The cross functional teams are full stack squads, lean agile methodology and follow a “DevOps” cycle approach. This help to redefine the software delivery process, the tooling that supports it, and the culture of the people involved in the entire process itself. The agile method is based on lean process and agile methodology principles in which, business owners, development, operations and quality assurance departments collaborate to deliver software in a continuous manner. Everyone involved in the process will have a high-level understanding of the end-to-end flow, enabling the business to capture market opportunities and reduce the time to include customer feedback”.</p>
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Teams using the agile product delivery innovation life-cycle work in cross functional teams that are collocated in one room. The businesses do have representatives in the same room daily. Decisions are taken with them; herby business and IT are aligned as interpretation of what the requirements are and what business value will be delivered next. To work agile team



members must understand what agile means and what agile is. It is more of an attitude and a mind shift. Previous challenges i.e. Top management not being involved were addressed.

4.7.1.1 Learn from mistakes

To work agile, team members use open communication where they can contribute to work better or faster without being afraid of making mistakes.

P7	People need to be risk-averse and take risk to try new things. They must be willing to take risks and learn from their mistakes.
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4.7.1.2 Open communication

Daily frequent feedback to the customers creates an atmosphere of open communication.

P10	Increase efficiency and effectiveness of communication by encouraging daily collaboration therefore managing stakeholder expectations.
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4.7.1.3 Collaboration work practices

Teams working innovatively are constantly working in a relationship of trust that everyone will do their tasks and it is not necessary to micro-manage tasks like in a waterfall approach. Everything is output-driven. Teams are also much more open to communicate daily as that is part of their methodology. They are also using network technologies, like SKYPE to meet virtually.

P24T15	We use MSLYNQ and SKYPE a lot. Virtual conferences and video conferences are held with teams across the country and overseas.
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4.7.2 Knowledge management challenges and strategy

Knowledge management challenges are those that emerged out of the use of, transferring of, gaining of and managing of knowledge and information.



4.7.2.1 Right intellectual property

For users to gain knowledge the right intellectual property needs (P6T15)

- **Right skill**

The right skill is needed doing the tasks if the resource does not have the right skill then the expected deliverable cannot be completed in time.

P6T48	<i>When there is a gap, then there is either a gap in the person's himself must learn or there was a gap in the person teaching the developers and I must replace some people along the way</i>
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- **Right Mentoring**

If resources do not get assistance from the right mentors, incorrect best practice or standards can be learned. Also, the subject matter experts (SME) can only be teach others as much knowledge as they themselves known. There is therefore limited knowledge transfer opportunity in the traditional waterfall method of work. In the agile innovation life-cycle, one of the best practices are to work together in learn together as a team.

P17t04	When asking for resources especially MW SME is difficult to get hold of. Knowledge is not shared. Those with the intellectual property (IP) cannot get to everyone. They are supposed to mentor others but it does not happen
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- **Right learning method**

P7T15	<i>Each person can choose which training method is the best method for learning the innovation life cycle - documenting or mentoring or online training or classroom.</i>
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Each person learns differently, some resources that are more of a self-help learn philosophy while others do want face-to-face communication. With the agile innovation life-cycle introduced, the attitude of the users is that they are willing to learn fast by themselves and are willing to help each other more often as before.

- **Right abilities**



Employees with the right skills and abilities do get promoted more often. Or get the opportunity to work on newer technologies, for an organisation to be able to uptake and absorb new technology, the IT capability to apply new technology need to increase. This all is due to the increasing client experience digital market forces.

P12T04	There are some resources in this department that do can learn faster than others, look at person X, person X do has a bright future
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Not all resources do can work with the latest technologies. Some also work in back-end with older technology and do a very good job of it. They are just as needed as the one working in the front-end. An organisation needs to apply its workforce to best its ability to support all IT applications and project initiatives across the enterprise. This also calls for a balance of resources with a range of skills and ability.

P12T15	“We have cross-skill mechanisms in place in my team for those with strong abilities. Skills are learned on the job with the vendor for those with the ability to do so.
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All the respondents said to have the right competency at the right time is crucial to be innovative.

4.7.3 Enterprise engineering challenges and strategy

The researcher had in-depth interviews with the enterprise architect that have designed and implemented the enterprise engineering life-cycle based upon GERAM (Bernus, Nemes, & Schmidt, 2012). The application of GERAM towards generic innovation life-cycle Louw (2010a & 2010d) can be viewed was depicted in section 2.8 (see figure 2-2). A summary of the interview in context specifically the application of GERAM, the innovation life-cycle implementation and strategies to overcome these challenges will be discussed.

- **How the enterprise engineering principles were applied**



The initiative has started in a small IT focus project to address the shortcomings in the previous methodology which was not designed for across multiple business units and have little standards and best practices. To design and enterprise innovation life-cycle an enterprise engineering reference framework was used. The generic architecture framework of GERAM (Bernus, Nemes, & Schmidt, 2012) identifies concepts of enterprise integration which employs an enterprise methodology (See appendix D) which describe process of enterprise engineering. The process of enterprise engineering provides constructs for modelling human role, process and technologies (see appendix D). The enterprise engineering principles are described on the diagram. How the GERAM enterprise engineering entity types map to an innovation life-cycle is described in Appendix E and F. Each entity type presents an enterprise engineering concept which is mapped to the phases of an innovation life-cycle. Each of the concepts was applied to form the perspective of how the innovation life-cycle was designed. The tasks/activities for each role and the governance quality gates based upon ISO / IEEE and GERAM. The system development life-cycle bought from IBM is a set of products using the IBM Jazz platform to integrate of tools together, Rational Team concert (RTC), Requirements composer, Rational Software Architect (RSA), Rational Test Manager (RTM). Within Rational Method composer the process flows, task, activities and resource roles were defined and exported and published to be referenced on share-point.

- **Challenges that occur during the application of enterprise engineering principles**

- **Too many standards and best practises applied**

The organization wants to cover all angles to make sure an enterprise perspective is covered; the methodology bought from IBM and with customization incorporating a lot of best practise contain all possible artefacts and activities possible. We introduce too many best practices. There were a lot of activities and task in the beginning which do not add value to the whole Innovation Life-cycle which had made the process costly and time-consuming. The whole process of implementing the Innovation Life-cycle have matured our thinking and have grown in standardizing tools, best practices and tools.



- **Life-cycle implementation applied in waterfall**

Lifecycle supports iterative development, but has been applied in a waterfall style. We have started with a big bang approach enforcing traditional methods the users are accustomed with to flesh out the stands, we should have started with iterative development straightaway in paralleled with the traditional waterfall method.

- **Support tools too complex, do not support iterative enterprise life-cycles**

The support tools were standardize set of tools and were bought in since to bring re-usability of the modelling in the enterprise. The tooling has failed due to the complexity of the application landscape to be modelled and primarily the business models were completed by each business cluster in isolation. The tools did not support sharing of variants of use cases across business clusters, the same for application models, each IT team do have their own version of the same component modelled storing in its own repository.

- **GERAM Framework no linkages towards organization activities**

The GERAM framework do not have any guidance how a governance framework and life-cycle processes link towards organisational processes and activities.

- **Strategies to apply when following an enterprise engineering approach**

- **Agile product delivery innovation strategy**

Check which activities have value and improve those. Remove those that are not adding value. Reduce cost of innovation process.

- **Instead of bottom up only, get top management buy in continually**

It was started small due to funding limited and therefore the implementation started small with a few pilot projects, the vision and plan of the methodology was not clearly communicated to all users. Top business management felt they were recognized and given ample opportunity to provide consultation of what



their expectation is what an innovation life-cycle needs to do for them. Few stakeholders new that, the methodology is based upon an enterprise engineering framework, the reasons and purpose why we implement the methodology. Top management from the non-IT side were not involve as it should, in contrary with the agile methodology implemented recently, they did work from bottom-up and top-down simultaneously.

○ **Flexible enterprise engineering standardise practices, methods and tools**

The enterprise architecture (EA) and application design and development departments were immature in their thinking what governance gates were and the best practices they need to standardize on ensuring consistent high quality of artefacts.

P1T63	The whole process of implementing the Innovation Life-cycle have matured our thinking and have grown in standardizing tools, best practices and tools.
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The application of the standards and practices has matured the users thinking contributing to apply more agile techniques and best practices. The organisation has matured in their enterprise portfolio management tool, called Alphabet and uses this for product portfolio management and alignment between business and IT strategy. Other tools to work more agile were JIRA and Confluence which make collaboration between SCRUM teams and visibility of what they are doing much easier

P15T04	"We have enhanced Alphabet to allow architects model the affected architecture with the information flows, platform architecture. We also have introduced a new template for the solution architecture document which guide the user which Alphabet view to put in."
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The organisation has adopted a philosophy of “just enough documentation” across all three-innovation life-cycles, the waterfall, hybrid-waterfall/agile and agile to do just enough documentation but still adhere to the standards.

Below is a summarized overview of diagram depicting each enterprise strategy that must be applied to specific enterprise engineering challenges that occur during the transformation process in an organization to implement an innovation life-cycle strategy and to implement the strategy. Each of the strategies overcome specific challenges as pointed by the arrows which are described in the Findings above and strengthened by literature in the Discussion Chapter 5 below.

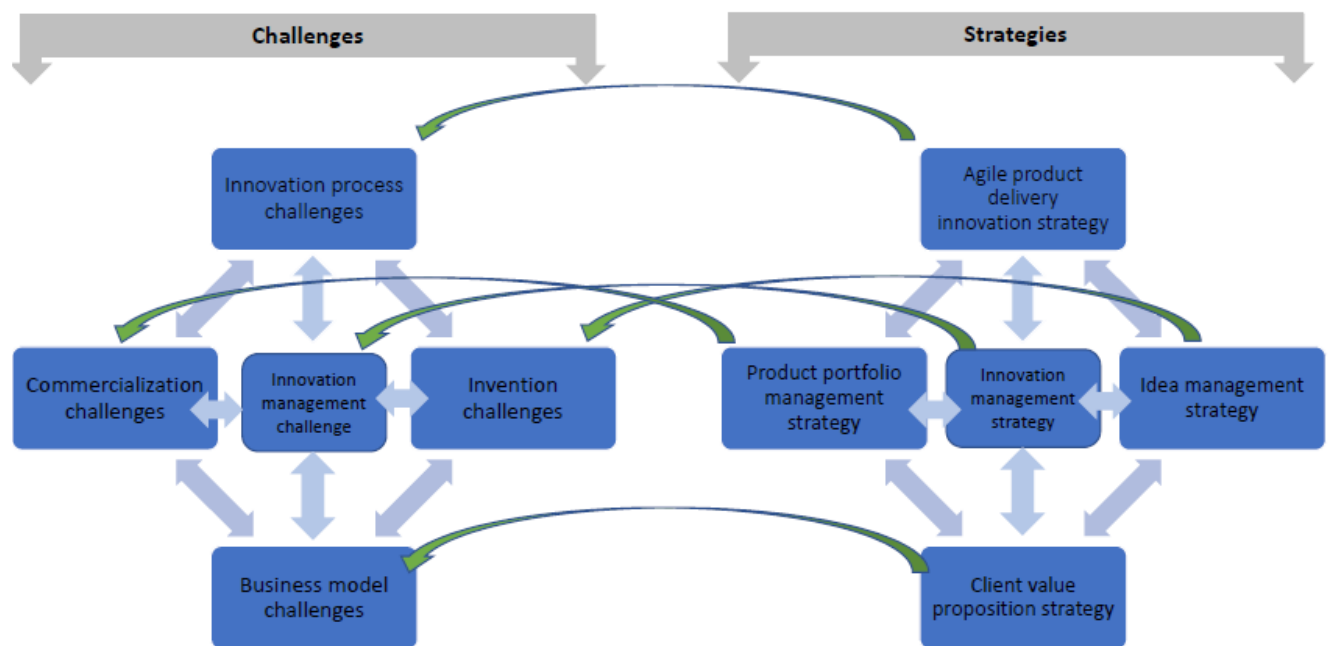


Figure 4-2 Enterprise strategies to apply to overcome an enterprise engineering innovation life-cycle challenges



5 Discussion

This discussion aims to integrate the concepts outlined in the findings with existing literature on agile product delivery innovation strategy, client's value proposition strategy, product portfolio management strategy and innovation management strategy.

No detail comparison has been done between the challenges emerged from this research study and those in existing literature. Challenges are discussed in context of the strategies needed as part of innovation management as the reasons and driver why we need specific strategies. The researcher is of ontological stance that the social environment between people and technology is changing continuously and subsequent research studies could show different results. The purpose of the challenges identified in this research study is not to provide a comprehensive list of challenges that do occur when implementing an innovation life-cycle but mere to use it to identify which strategies were employed to overcome them.

The main purpose of the literature after the findings is to compare the theoretical concepts researched against current knowledge and to depict where current contributions were made in context of scholarly literature. Another aim is to strengthen the model and confirm the relationships between the strategies. In context of each strategy discuss the most common challenges or reasons why a strategy must be employed are described.



This correspond to the main purpose of the theoretical model is to contribute to the implication in practice when these strategies can be used to overcome challenges related to a strategy when implementing an innovation life-cycle. Challenges similar in nature can be addressed by the strategies provided.

The discussion has been kept to the essential points of discussing the strategies in context of an innovation life-cycle and enterprise engineering.

5.1 Agile product delivery innovation strategy

Schulz, Steinhoff, & Jepsen (2017) have done case studies that do show that more agile, tailor-able and flexible innovation life-cycles need to be developed. These needs to be more adaptive and flexible than in the past (Cooper, 2017).

According (Léveillé, 2011) product focussed software processes improve the expected deliverables by incorporating quality by design, quality by validation and the quality by defect management measurements. To deliver of software product of high quality a process improvement strategy is one of the most common methods ensuring this (Chevers and Grant, 2016; Shih and Huang, 2010). Software process improvement can also be used as a tool to align business and It strategy (Göbel, Cronholm, Hallqvist, Söderström and Andersson, 2014). This concludes the linkages between “product portfolio management” strategy towards “client value proposition” strategy and “client value proposition” strategy.

Open innovation models integration with business strategy, IT strategy, innovation culture and communication need to be followed (Pfeffermann & Gould, 2017).

5.2 Idea management strategy

Idea management and knowledge management are an integral part of innovation (Brunswick-er & Vanhaverbeke, 2015). The forming and management of ideas do have a very strong relationship according (Sarooghi, Libaers, & Burkemper, 2015). Without quality ideas and an environment for stimulating ideas organizations will fall behind the competitive edge in the market place. Idea management will therefore enable organisations to generate ideas from all perspectives and contribute to connecting employees with one another, sharing ideas and exploring new ideas.



5.3 Client value proposition strategy

Client value propositions are those products and services targeted for a specific client, the client experience and the value it will add to the client buying and using the product. (Payne, & Frow, 2014). Customer value propositions are created in collaboration and communicating with customer really need and want. (Payne, Storbacka & Frow, 2008). The value is co-created such that when the value of what the client wants is determined then that become the additional features that form part of the product or service. Business need to re-design their business model to reflect client value propositions moving away from product centric models to client centric models (Joyce & Paquin, 2016). Defining an enterprise business model for use by enterprise architecture is how business and IT alignment are supported by an enterprise engineering approach (Niemann, 2006; De Haes & Van Grembergen, 2015). Enterprise value chain activities is not only a set of activities related to product design, production, sales and marketing but also to show the interdependence among the relevance value activities (Liao, 2017). This means that an enterprise product strategy is needed to integrate the different strategies of each business unit.

As described earlier the client value proposition chain determines the enterprise capabilities needed, likewise the integration of the value chain across an organization gives a holistic perspective and are mapped to enterprise business objectives (Lukhele, Ngassam, and Osunmakinde, 2014). Enterprise product strategy integrates these views so that the interdependence between the relevance products and services needed can be evaluated (Liao, 2017).

A business architecture capability meta model has been proposed (Du Toit & Tanner, 2015) that do show the relationship between an organization's strategy is fulfilled by and supported by business capabilities. The need to have a proper tool-set to overcome the challenges of fragmented business model and business analysis have also been described by (Du Toit & Tanner, 2015). Impact analysis can be more accurate if the correct business modelling framework and reference model with proper tool-set can be used (Du Toit & Tanner, 2015). A design pattern to determine function point count on business capability level be made possible by making sure the correct tool-sets are integrated up to IT component model during



requirements and component modelling. The dependency between business and IT components during feasibility studies can therefore be made visible and traceable (Du Toit & Tanner, 2015). This would be a valuable tool for enterprise architecture management to determine the impact during product and portfolio management using an enterprise architecture management tool which coherently harvest modelling information from the asset libraries (Du Toit & Tanner, 2015).

5.4 Product portfolio management strategy

According (Apel, Batory, Kästner, & Saake, 2016) there need to be a feature software product line strategy to make sure the features are grouped together. This has been confirmed by Schwägerl, & Westfechtel (2017) that feature-oriented domain analysis (FODA) assists with the management of the portfolio of projects. To manage product portfolio there, need to be appropriate tools make a digital product portfolio (Nylén, & Holmström, 2015).) to assess the value of the offerings. A study by Ahmad, Lwakatare, Kuvaja, Oivo, & Markkula (2017) demonstrate agile project management use Kanban to show the overview and the status of product portfolio offerings. According (Nylén et. Al, 2015) are the user experience and value proposition focus crucial factors making agile project management successful. To have a proper product portfolio management strategy was confirmed by Tolonen, Shah-marichatghieh, Harkonen, & Haapasalo (2015).

A case study (Alonso, Verdun, and Caro, 2013) reveals that between 30% to 40% IT executives and business executives do not knew what strategic IT demand management was. Most participants in this case study only perceive this as an IT function to control and monitor IT operational demands. Strategic IT demand management (McKeen, Smith, Gonzalez, 2012) is an organisational capability of enterprise architecture, enterprise programme office and across business units working together to on strategic initiative management for prioritizing and funding IT investments at the enterprise level.

The findings here have shown that one of the key challenges is to have a strategy to address the challenge where multiple projects are active at the same time over siloes of business unit and where the business units are not aligned towards the capabilities that must be delivered. Managing numerous projects simultaneously at the same time becoming a key competency (Jonas, 2010). The PMO managers need top management support in making key decisions



(Jonas, 2010). To align projects one needs to be able to determine the compatibility between projects (Dye & Penypacker, 2002) with a strategic object (Unger & Gemünden & Aubry, 2012). As mentioned by one of the respondents, the alignment will come through building enterprise capabilities, which share common client value propositions across all business units. Therefore, there needs to be a function within an organisation to link the project portfolios with the business strategies (Kaiser, El Arbi & Ahlemann, 2015) which is called enterprise programme management office (Gaddie, 2003; Williams and Parr, 2004).

5.5 Culture of innovation strategy

Organisational Culture is the how people in an organisation work, behave towards others and the way they think and making decisions (Dharmayanti, Coffey and Trigunarsyah, 2012) and can influence IT project selection and the methodology executing the software process. Culture do have an impact on software process improvement (Shih, and Huang, 2010; Iivari, and Iivari, 2011);

To move from to a traditional way of working towards an agile way of working need a culture change (Iivari, and Iivari, 2011). The basis for innovative is to have open communication and allow the workforce to be creative and innovative during the process (Leong and Anderson, 2012).

5.5.1 Innovative workforce – strategy

One of crucial methods to keep employees and be sustainable being competitive in the market is to have an innovative workforce (Meister, Willyerd and Foss, 2010). Having an innovative workforce requires knowledge, skills, abilities, personality balances between team members and motivation factors like climate, rewards, recognition, leadership, team processes and the right resources (Hunter, Cushenbery and Friedrich, 2012). Another important trait is intellectual property as a strategy to have a competitive edge (Wang, Wang, and Liang, 2014). Teece (2010) propose knowledge sharing dynamic capabilities within an organisation to be create a culture of innovation.



This therefore align with the theoretical model of this research study that business capabilities need to be managed on an enterprise strategic level together with enterprise capability resource planning.

5.6 Knowledge management strategy

As mentioned earlier in section 5.2 that idea management and knowledge management (Brunswicker & Vanhaverbeke, 2015) are not without each other. If an idea grow into innovation then knowledge is gained how such an idea are proposed and function, this by itself is knew knowledge not previously explored. Organizations want to be sustainable in the growth in the marketplace towards competitors. To grow going forward in this digital age of technology companies must manage knowledge through an innovation management strategy effectively (Lopes, Scavarda, Hofmeister, Thomé, & Vaccaro (2017).).

5.7 Innovation management strategy

More and more companies realise their agile practices do not align with software product development (Dzamashvili Fogelström, Gorschek, Svahnberg, & Olsson, 2010) and moving from software development projects to software product management (Vlaanderen, Jansen, Brinkkemper, & Jaspers (2011). Per Meskendahl (2010) there is a relationship between the strategies of a business project portfolio management success. This mean how it will grow in the market place, have product and pricing differentiation, and align project portfolios towards business strategy. The simultaneous execution of product-focussed agile delivery projects make the requirement management complex (Vlaanderen, Jansen, Brinkkemper, & Jaspers, 2011). Organisations must be open-minded to learn from experiences and adjust to improve the design and development practices (Vlaanderen, Jansen, Brinkkemper, & Jaspers, 2011).

Software process improvement (SPI) is a strategy is a means for organizations to be more flexible and agile in response to customer needs and to gain a competitive advantage (Clarke and O'Connor, 2012). There need to be a strong drive from strategic vision of an organization towards what goals process improvement strategy need to achieve to support an organization's strategies delivering products and services (Clarke and O'Connor, 2012). This supports the "reduce to market strategy" within "client value proposition strategy" described above.



5.7.1 Alignment of the skills and competencies needed for projects

A research study by Liu et al (2010) has shown that for a project to be successful, the right competency and skills are needed in a team. It also shows that individual competency levels have a collective influence on team performance.

5.8 Implications for Research

As stated in the research question the focus of the study was mainly on the innovation-life-cycle, the challenges when implementing and improve it and the strategies to overcome it. The theoretical model contributes to the body of knowledge mainly in the innovation life-cycle domain. However, the research also contributes to the field in enterprise engineering explaining of the application of an enterprise engineering framework, the challenges to apply it in an enterprise context and the strategies to overcome it.

This research has searched to extent the body of knowledge in respective of the theory of innovation life-cycle by merging the application of theoretical model of a generic innovation life-cycle (van Zyl, 2006) with those of enterprise engineering framework. The conclusions have been verified to describe accurately the perspective and the experiences of the subjects and the conditions of the case study using triangulation by way of having follow-up interviews with the same participants and additional research participants not initially identified in the research study, also by having observations in context of different project types i.e. agile and waterfall and lastly document analysis on documents received from process improvement team and management. Due to the vast domain covered only the essential elements are depicted aligning with the scope of the research questions only. For example, only the essential aspects of enterprise engineering framework and the application thereof were shown but the bulk are still focusing on the innovation life-cycle. The findings and results can be applied to other theories this was shown by explaining the relationship between a generic innovation life-cycle, an adopted traditional waterfall and agile principles that were applied. Literature from Marais, & Schutte, (2009) that the application of generic innovation life-cycle towards



open innovation models thereof can use as a guide to apply this theory to any innovation life-cycle. Literature review after the findings shown in the discussion chapter also confirm the strategies needed for each challenge occurring in context of an innovation life-cycle and innovation management.

5.9 Implications for Practice

This research can be successfully applied in practice due to the findings and results has emerged out a field by following a grounded theory approach where the theories have been applied. Organizations constantly seeking for ways to improve management practice and to be innovative to stay competitive in the market place.



6 Conclusion

6.1 Innovation life cycle purpose

To convert innovation ideas into successful projects a quality gate methodology combined with a generic enterprise product life cycle have been proposed (Giebel et al., 2009). Grönlund et al. (2010) have combined the innovation process with a stage-gate process for new product development. It is shown that there is a need to have alternative approaches towards implementing or executing an innovation life cycle from an enterprise perspective and ensuring the quality (Giebel et al., 2009; Grönlund et al., 2010). To bridge innovation and enterprise systems disciplines, Lokuge, & Sedera, (2014) have shown the need to have innovation defined in the context of its constraints namely people, technology processes and organisation, through which a perspective of an innovation type called continuous restrained innovation (CRI) is given. An innovation life cycle, therefore, can have many faces and applications. Enterprise engineering is such an approach looking at an organisation's process, people and technology from a wider perspective than just a silo vision of from one department of an organisation to another. Business agility also demands the business functions, business processes, structure, and technology of an organisation to adapt quickly (Zand, 2011).



6.1.1 Primary research question

Which strategies could be employed to implement an Enterprise Engineering Innovation Life Cycle (EEILC), to overcome related challenges?

Answer:

A theoretical model with detail explanations is presented in chapter 4. The application of enterprise engineering principles, its challenges and strategies related to innovation life-cycle are described at the end of chapter 4.

6.1.2 Secondary research questions

(1) What are the challenges experienced by various role players while using an EEILC?

Answer:

Seven core challenges were identified of the innovation process challenges causing slow time to market, the business model challenges, siloed enterprise capabilities, the commercialisation challenges misalignment between business and IT project priorities and innovation management challenges where the absence “culture of innovative” slow down innovative solution coming forward.

(2) How are proposed strategies employed to address the EEILC challenges?

Answer:

There are seven proposed strategies categories of which an agile product delivery innovation strategy and client value proposition strategy were very prominent due to the drive to build enterprise capability features for the organisation in an incremental product portfolio managed manner which can be re-used across business units.



The theoretical model can be used by practitioners as a guide to implement an enterprise engineering innovation life cycle. All the pitfalls and challenges of the approach are highlighted and some best practices were also added.

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APPENDIXES

APPENDIX A – INTERVIEW QUESTIONS

Section A: Demographics

- What is your position in the organisation?
- Organisation size?
- Industry sector?
- Describe your level of experience in IT.
- Describe your level of experience in Innovation Life-cycle.

Section B: Research Questions – System Development Life-Cycle

What is Innovation Life-cycle

- Describe what Innovation Life-cycle is in your organisation.
- Describe how you see an Innovation Life-cycle
- Can your Innovation Life-cycle be broken down into domains or application areas?
- Are there other domains in your Innovation Life-cycle not listed in the previous question?
- Describe the high-level contents of Innovation Life-cycle for each domain.

Why do Innovation Life-cycle?

- What are the goals, objectives of the Innovation Life-cycle in your organisation?

How is Innovation Life-cycle used?

- How Innovation Life-cycle is performed in your organisation?
- Describe if the organization use any Industry Frameworks assisting with the activities and tasks during the Innovation Life-cycle?
- Describe if the organization use any Industry Standard based Methodologies assisting activities and tasks during the Innovation Life-cycle?
- What tools are used in your practice of Innovation Life-cycle?
- Do you have any Innovation Life-cycle measurements or metrics in relation to Innovation Life-cycle (e.g. Maturity of methodology, tools and practices, current state vs future state etc.)?
- Describe how you capture/model your enterprise solutions according requirements?

- Discuss all the stakeholders involved in you Innovation Life-cycle exercise
- Discuss your use of smart source vendors or external consultants during the application of the innovation Life-cycle (Purpose, Why, Who, Frequency, Problems).
- How many resources are employed for Innovation Life-cycle, what are their qualifications? and duties?
- Who is in charge of Innovation Life-cycle in your organisation?
- Who uses Innovation Life-cycle, and why?
- Discuss the skills required for Innovation Life-cycle and the availability of those skills?

When do you do Innovation Life-cycle?

- Discuss the frequency and usage of your Innovation Life-cycle exercise?
- Are all the different departments/clusters using the Innovation Life-cycle?

Section C: Research Questions – Challenges when using System Development Life-Cycle

What are the challenges for each of the main entities of the Innovation Life-cycle in respective of the areas listed below?

- Strategic Management entity (demand, ideas, value chain ect.)
- Enterprise engineering entity (EA and ADM)
- Enterprise entity (operational)
- Product entity (value chain)
- Methodology chosen/used
- Phases of Methodology – Prioritization, Pre Execution, Business Funded, Execution, use of

What are the mitigating strategies are put in place to overcome these challenges in respective of the areas listed below?

- Strategic Management entity (demand, ideas, value chain ect.)
- Enterprise engineering entity (EA and ADM)
- Enterprise entity (operational)
- Product entity (value chain)
- Methodology chosen/used
- Phases of Methodology – Prioritization, Pre Execution, Business Funded, Execution, use of

APPENDIX B – ETHICS FORM



UNIVERSITY OF CAPE TOWN
FACULTY OF COMMERCE
 Igniting Knowledge and Opportunity



Commerce Faculty Ethics in Research Application Form

Any person planning to undertake research in the Faculty of Commerce at the University of Cape Town is required to complete this form **before collecting or analysing data**. If any of the questions below have been answered YES, and the applicant is NOT an Honours student, the form it should be submitted to the supervisor (where applicable) and from there for approval by the Faculty EIR committee: Ms Samantha Alexander (samantha.alexander@uct.ac.za).

It is assumed that the researcher has read the UCT Code for Research Involving Human Subjects (Available at <http://web.uct.ac.za/depts/educate/downloads/uctcodeforresearchinvolvinghumansubjects.pdf>) in order to be able to answer the questions in this form.

Students must include a copy of the completed form with the dissertation/thesis when it is submitted for examination.

1. PROJECT DETAILS			
Project title:	The factors impacting the usage of an Enterprise Engineering based software development lifecycle and its antecedents on company performance		
Principal Researcher/s:	Franscois du Toit	Email address(es):	francoisdtoit@gmail.com
Research Supervisor:	Dr. Maureen Tanner	Email address(es):	mt.tanner@uct.ac.za
Co-researcher(s):		Email address(es):	
Department:			
Brief description of the project:			
<p>Title: The factors impacting the usage of an Enterprise Engineering based software development lifecycle and its antecedents on company performance.</p> <p>Primary research question: What are the challenges experienced and the perceived factors that influence company performance while using and enterprise engineering system development life-cycle within a large financial organization.</p> <p>Secondary research question:</p> <ol style="list-style-type: none"> (1) What are the challenges experienced by various role players while using an EESDLC (2) How is an EESDLC implemented within a large financial service provider organization X. (3) What are the perceived factors influencing company performance (4) What are the company performance measures (5) What mitigating strategies are put in place to overcome the challenges <p>Purpose: To understand and to develop theoretical model of the concepts that are connect to, grounded in or emergent from real life events and circumstances from the challenges experienced when using Enterprise Engineering based SDLC within a large financial provider organization.</p>			

As described in the section 2.1 "Problem statement" within the Literature review and research design document, little research have been done and further research is needed looking at implementing and using software methodologies which are based upon enterprise engineering principle in the South African context.

Data collection: (please select)

- ☒ Interviews ☐ Questionnaire ☐ Experiment ☐ Secondary data ☐ Observation
☐ Other (please specify): _____

Have you attached a research proposal OR a literature review with research methodology? (please select) ☒ Yes ☐ No

2. PARTICIPANTS

2.1 Does the research discriminate against participation by individuals, or differentiate between participants, on the grounds of gender, race or ethnic group, age range, religion, income, handicap, illness or any similar classification?	YES	NO
2.2 Does the research require the participation of socially or physically vulnerable people (children, aged, disabled, etc.) or legally restricted groups?	YES	NO
2.3 Will you be able to secure the informed consent of all participants in the research? (In the case of children, will you be able to obtain the consent of their guardians or parents?)	YES	NO
2.4 Will any confidential data be collected or will identifiable records of individuals be kept?	YES	NO
2.5 In reporting on this research is there any possibility that you will not be able to keep the identities of the individuals involved anonymous?	YES	NO
2.6 Are there any foreseeable risks of physical, psychological or social harm to participants that might occur in the course of the research?	YES	NO
2.7 Does the research include making payments or giving gifts to any participants?	YES	NO

If you have answered YES to any of these questions, please describe how you plan to address these issues (append to form):

Affiliations of participants: (please select)

- ☒ Company employees ☐ Hospital employees ☐ General public ☐ Military staff ☐ Farm workers ☐ Students
☐ Other (please specify): _____

The consent is recorded during the interview and the name of the interviewee will be erased from the audio recording keeping the interview data intact but removing mentioning of their name in beginning of the interview during greet and meet.

Race / Ethnicity:

Are you asking a question about race/ethnicity in your questionnaire?

☐ Yes ☒ No

Which race categories have been used?

Have you included the option: "Prefer not to answer" as part of your race/ethnicity question? N/A

3. PROVISION OF SERVICES

Does your research involve the participation of or provision of services to communities?

If your answer is YES, please complete below:

3.1 Is the community expected to make decisions for, during or based on the research?	YES	NO
3.2 At the end of the research will any economic or social process be terminated or left unsupported, or equipment or facilities used in the research be recovered from the participants or community?	YES	NO
3.3 Will any service be provided at a level below the generally accepted standards?	YES	NO

If you answered YES to any of these questions, please describe below how you plan to address these issues.

N/A

3. ORGANISATIONAL PERMISSION

If your research is being conducted within a specific organisation, please state how organisational permission has been/will be obtained:

Consent have been given by the head of the architecture department I am working in that I may participate with employees that do work in the IT department. My Thesis is also as part of my learning objective outcome captured on the HR system. The organization has signed the consent form that goes with the UCT covering letter.

Have you attached the letter from the organisation granting permission? (please select)

☒ Yes ☐ No, but this will be obtained before commencing the research ☐ Not applicable The department manager has signed the consent form. They feel they have signed the consent form and that is sufficient.

Are you making use of UCT students as respondents for your research? (please select)		<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No
If yes, have you contacted Executive Director: Student Affairs for permission? (please select)		<input type="checkbox"/> Yes	<input type="checkbox"/> No
Was approval granted? (please select)		<input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> Awaiting a response
		N/A	
Are you making use of UCT staff as respondents for your research? (please select)		<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No
If yes, have you contacted Executive Director: Human Resources for permission? (please select)		<input type="checkbox"/> Yes	<input type="checkbox"/> No
Was approval granted? (please select)		<input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> Awaiting a response
		N/A	
Contact Emails: Executive Director: Human Resources (Miriam.Hossain@uct.ac.za) Executive Director: Student Affairs (Meenina.Khan@uct.ac.za)			
4. INFORMED CONSENT			
What type of consent will be obtained from study participants?			
<input checked="" type="radio"/> Oral Consent <input type="radio"/> Written Consent <input type="radio"/> Anonymous survey questionnaire (covering letter required, no consent form needed) <input type="radio"/> Other (please specify)			
How and where will consent/permission be recorded? Recorded via audio file per interviewee.			
Have you attached an informed consent form to your application? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No			
5. SPONSORSHIP OF RESEARCH			

If your research is sponsored, is there any potential for conflicts of interest?

If your answer is YES, please complete below

4.1 Is there any existing or potential conflict of interest between a research sponsor, academic supervisor, other researchers or participants?	YES	<input checked="" type="radio"/> NO
4.2 Will information that reveals the identity of participants be supplied to a research sponsor, other than with the permission of the individuals?	YES	<input checked="" type="radio"/> NO
4.3 Does the proposed research potentially conflict with the research of any other individual or group within the University?	YES	<input checked="" type="radio"/> NO

If you have answered YES to any of these questions, please describe how you plan to address these issues (append to form)

6. RISK TO PARTICIPANTS

Does the proposed research pose any physical, psychological, social, legal, economic, or other risks to study participants you can foresee, both immediate and long range? (please select)

☐ Yes ☒ No

If yes, answer the following questions:

1. Describe in detail the nature and extent of the risk and provide the rationale for the necessity of such risks
2. Outline any alternative approaches that were or will be considered and why alternatives may not be feasible in the study
3. Outline whether and why you feel that the value of information to be gained outweighs the risks

1.
N/A

2.
N/A

3.
N/A

I certify that I have read the the Commerce Faculty Ethics in Research policy ☒
 (<http://www.commerce.uct.ac.za/Pages/ComFac-Downloads>)




I hereby undertake to carry out my research in such a way that:


- there is no apparent legal objection to the nature or the method of research; and
- the research will not compromise staff or students or the other responsibilities of the University;
- the stated objective will be achieved, and the findings will have a high degree of validity;
- limitations and alternative interpretations will be considered;
- the findings could be subject to peer review and publicly available; and
- I will comply with the conventions of copyright and avoid any practice that would constitute plagiarism.

Signed by:

	Full name and signature	Date
Principal Researcher/Student:	Francois du Toit	2015-10-30
Francois du Toit	Signed by candidate	

This application is approved by:

Supervisor	Dr. Maureen Tanner	
HOD (or delegated nominee – for all Honours Projects):		04/05/2016
Chair: Faculty EIR Committee (only for postgraduate research at Master and PhD level)	 Prof U Rivett	5 May 2016

CHECKLIST	SELECT
A full copy of a research proposal or a literature review with methodology is attached in a separate file	<input checked="" type="checkbox"/>
Interview schedules / cover letters / questionnaires / forms and other materials used in the study are attached in separate files	<input checked="" type="checkbox"/>
Organisational consent letter / UCT student or staff approval letter (See notes above)	<input checked="" type="checkbox"/>
<p>On your cover letter to your questionnaire have you included the following?</p> <p>1. The following UCT Logo </p> <p>2. A sentence explaining the aim of the research</p> <p>3. Sentences of a similar nature to below must be included in the cover letter or consent form:</p> <p>This research has been approved by the Commerce Faculty Ethics in Research Committee.</p> <p>Your participation in this research is voluntary. You can choose to withdraw from the research at any time.</p> <p>The questionnaire will take approximately X minutes to complete</p> <p>You will not be requested to supply any identifiable information, ensuring anonymity of your responses.</p> <p>Due to the nature of the study you will need to provide the researchers with some form of identifiable information however, all responses will be confidential and used for the purposes of this research only.</p> <p>Should you have any questions regarding the research please feel free to contact the researcher (insert contact details). Francois du Toit at: francoisdutoit@gmail.com / 0824564564</p> <p>4. Have you scanned in your signature for the last section of the form?</p>	<p>NA. <input type="checkbox"/></p> <p><input checked="" type="checkbox"/></p> <p><input checked="" type="checkbox"/></p> <p><input checked="" type="checkbox"/></p> <p><input checked="" type="checkbox"/></p> <p><input checked="" type="checkbox"/></p> <p><input checked="" type="checkbox"/></p> <p>OR</p> <p><input type="checkbox"/></p> <p><input checked="" type="checkbox"/></p> <p><input checked="" type="checkbox"/></p>

APPENDIX C – CONSENT FORM



Department of Information Systems

Leslie Commerce Building

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1 May 2015

Dear Sir/Madam,

I am currently enrolled as a part-time Masters student at the University of Cape Town (UCT) in the Department of Commerce: Information systems. A requirement of the course curriculum is that I need to complete a technical report on research. The research topic and data collection method has been approved by the UCT's Commerce Faculty Ethics in Research Committee.

The purpose of this research is to understand the challenges experienced when using Enterprise Engineering based SDLC within this organization, a large financial provide. The data collected will then be used to compile and to develop theoretical model of the concepts that are connect to, grounded in or emergent from real life events and circumstances from using the SDLC from within a South African context. The results and findings could be used to improve and to assist with similar initiatives in this field.

Your participation in the research would be greatly appreciated. Any participation in this research is voluntary and all information provided as part of the research will be treated with the strictest confidentiality. No individual names will be recorded or published. You will not be requested to supply any identifiable information, ensuring anonymity of your responses. You can choose to withdraw from the research at any time for whatever reason, in accordance with ethical research requirements

The findings obtained from the research topic will be compiled in a technical report and presented to the University of Cape Town for academic purposes. None of the participant's details or the company that they represent will be published in any part of the paper. Copies of this research paper will be made available to all participants should they so desire.

If you give consent that employees in your department may willingly to participate in this study please sign the attached consent form.

Should you have any questions regarding this research, please feel free to contact me on +27 82 4564564 or email: francoisads@gmail.com

Sincerely,

Francois du Toit

Masters Student
Department of Information Systems
University of Cape Town

Signed by candidate

Maureen Tanner

Research Supervisor
Department of Information Systems
University of Cape Town

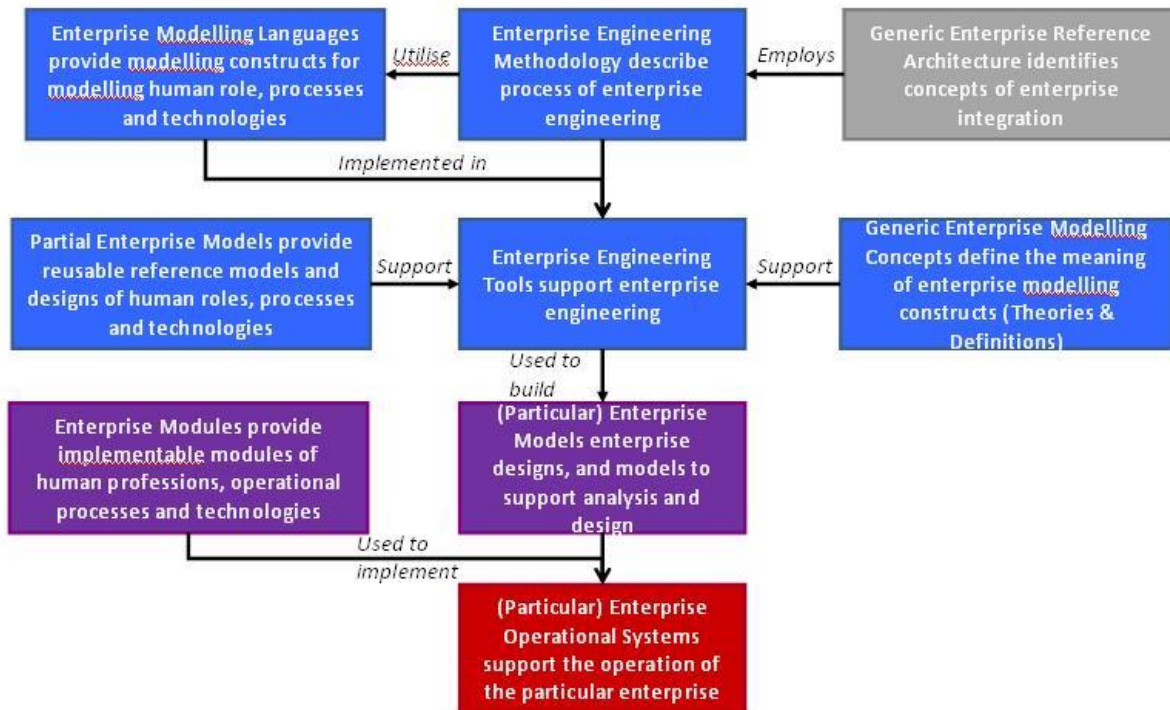
Research Participant Consent Form

I, Paul van der Merwe, consent to participate in the research to evaluate Innovation Life-cycle and Tools that support it. I do give consent that employees in my team may willingly to participate in this study and that they may choose to withdraw from this study at any time, should I choose to do so.

BvdM
Signature

19/05/2015
Date

APPENDIX D – GERAM ENTERPRISE ENGINEERING PRINCIPLES

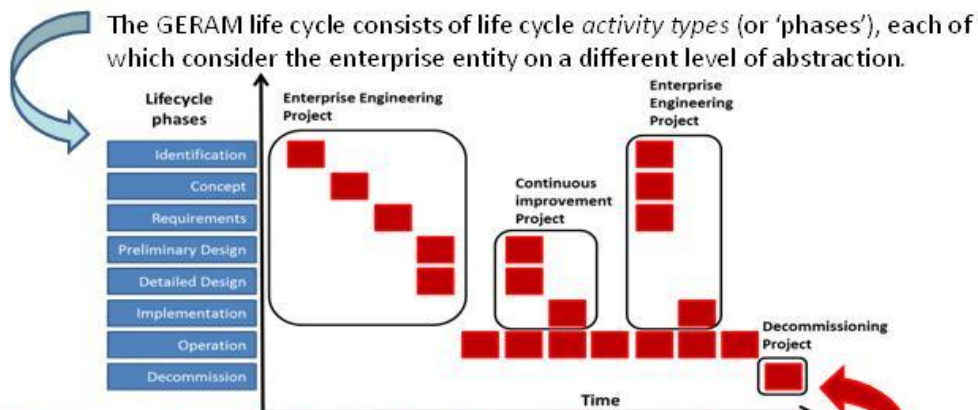


Author: Louw (2010b & 2013)

APPENDIX E – GERAM INNOVATION LIFE-CYCLE

The GERAM life-cycle concept can be used in two ways:

1. models used in deliberate enterprise engineering activities (where models on various life cycle levels are utilised for design, to direct change), and
2. models can be produced, on any appropriate life cycle level, to assess and make sense of *emergent* change

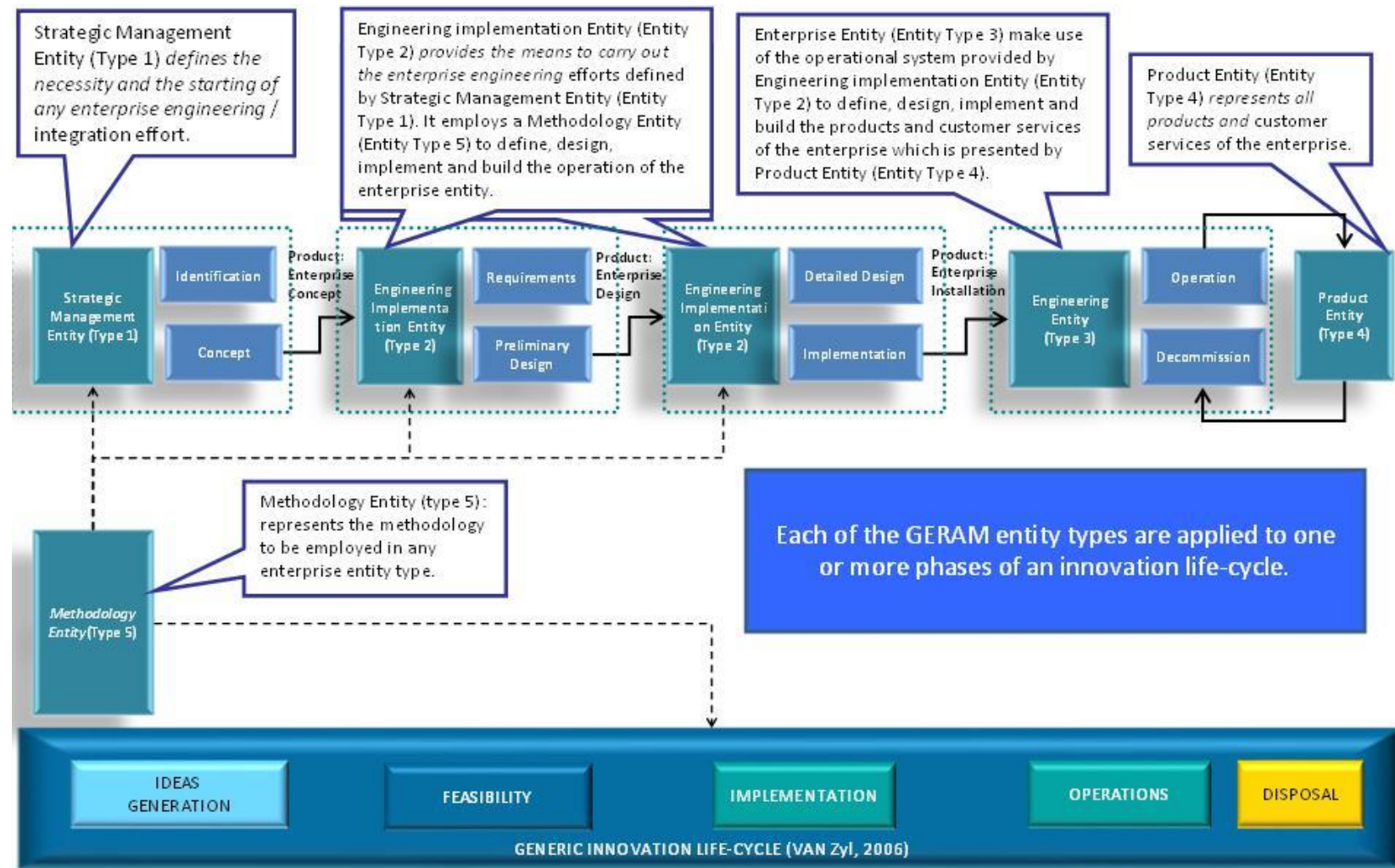


The life history of an entity describes how changes to the entity happen in time. A life history consists of life cycle activity instances, which in turn may form sequences of events (with some parallelism).

The timeline of the evolution of an entity may be subdivided into life history stages and milestones may also be defined.

Author: Louw (2010c & 2013)

APPENDIX F – GERAM ENTITY TYPES MAP TO INNOVATION LIFE-CYCLE



Author: Louw (2010d)

